

The Influence of Mineral Resources Exploitation on Environment and Countermeasures

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Abstract

This paper summarizes the negative effects of mineral resources exploitation. It makes a detailed statistics on the environmental impact of mineral resources exploration in Anshan, and it systematically analyzes the main factors of environmental damage caused by mineral resources development by combination of questionnaire survey and practical investigation. Based on the concept of sustainable development, the study put forward the “Green” management concept to improve the urban environment deterioration, including “Green” purchasing, “Green” production, “Green” marketing and “Green” education, so as to build a green industrial chain for the green development and deep processing of urban mineral resources.

Keywords

Mineral exploitation; Environmental pollution; Countermeasures.

1. Introduction

Chinese industry has continued to develop since Chinese reform and opening, especially the development of mineral resources has always been among the top in the world. Correspondingly, it has brought serious negative effects to the environment with the rapid development of mining, metallurgy, product fine processing and other fields. While the development of mineral resources has promoted economic growth, it has led to varying degrees of resource depletion, environmental pollution, ecological destruction and regional development decline in some countries or regions. At present, there are three main types of environmental problems, namely, environmental pollution, ecological damage and geological disasters. Environmental pollution includes air pollution, water pollution and soil pollution [1,2]. For example: the e-waste caused by the development of mineral resources and finely processed products is piled up like a mountain. In the open environment, these wastes, especially heavy metals, are carried into the water body by rain, or the formed fine particles are floated into the air and fall into the air through natural precipitation to cause the soil and air to be directly polluted, this means that reasonable development of mineral resources is the best way to maintain environmental sustainability [3-5]. A reported show that mercury contained in a button battery can pollute 600,000 litres of water [6]. In addition, the waste products formed by the development of minerals indirectly take the harmful wastes in the environment into the human body by the respiratory tract, digestive tract or skin in the form of air, water or soil, such as heavy metal pollution of the sea [2]. In the process of mining mineral resources, the mine occupies a large area of forest, grassland, farmland, etc. And the collapse of the mining area destroys a large amount of natural vegetation.

Vegetation destroyed by mineral source results in the destruction of vegetation was further enlarged based on damaged vegetation area is not restored and protected in time, reclamation and other measures are not taken, or the degree of restoration measures such as reclamation

and land restoration is low, which further expands the area of vegetation damage[8-11]. Due to the failure to restore and protect the damaged vegetation area in time, or the low degree of restoration measures such as reclamation and farmland return, the damaged vegetation area is further expanded [8-11]. In areas with a certain slope, it also causes soil erosion due to failure to take timely protection measures after mining, which seriously threatens the balance of the ecosystem [9,10].

2. Environmental Impact of Mineral Resources Exploitation

The “three wastes” generated during the development of mineral resources, namely waste water, waste gas and waste residue, directly endanger the surrounding ecological environment and cause more serious damage [5,11]. Statistics of environmental issues caused by mineral resources exploitation in China by July 2017 are shown in Table 1.

Table 1: Statistical results of environmental issues caused by mineral resources exploitation in China

Environmental issues	Class	Area (10,000 mu)	Radio (%)
Water and soil loss	Mild	2.89	7.53
	Intense	6.11	15.35
	Very intense	1.63	1.89
Groundwater recession	Mild	1.68	3.38
	Medium	8.39	16.92
	Serious	1.35	3.12
Mining collapse	Mild	2.29	4.63
	<u>Medium</u>	9.68	17.24
	<u>Serious</u>	3.64	5.98

It can be seen from Table 1 that the development of mineral resources has brought urgent pressure to Chinese environmental protection. This paper takes Anshan, the “steel capital” city as the object of study. By summarizing the impact of mineral resources development in Anshan City on water, soil, air and vegetation, it concludes the impact of mineral resource development on Anshan's overall environmental factors and the main problems in the environmental management and construction of the “Steel Capital” city.

2.1. Effects of Mineral Resources Exploitation on Water Pollution

Anshan City is a city mainly used for groundwater supply [12]. It is the largest iron and steel industry base and has relatively abundant iron ore resources in China. There are 6 open-pit mining mines in Anshan City, including Qidashan Iron Mine, Dagushan Iron Mine, Yanqianshan Iron Mine, Donganshan Iron Mine, Anqian Mining (Hujiamiaozi) Iron Mine and Gongchangling Open-pit Iron Mine. Groundwater pollution is most likely one of the causes of mining or processing plants. As early as 2016, some researchers reported that the Donganshan sintering plant was one of the pollution sources of the exhaust tail.

In addition, the tailings of the iron dressing plant contain a large amount of flotation reagents, and the tailings slurry discharged into the tailings pond also poses a great threat to groundwater pollution. The ingestion of polluted water sources by people, animals and plants will cause various Symptom [13]. Therefore, the water pollution caused by the development of iron ore resources should arouse the attention of enterprises and governments.

2.2. Effects of Mineral Resources Exploitation on Soil Pollution

The problem of heavy metal pollution caused by mining development has become increasingly prominent, and it has caused obvious regional soil environmental problems through water, solid waste, and atmospheric transmission. Once heavy metals (Pb, Zn, As, Hg, etc.) enter the soil, they are not easily degraded by microorganisms, causing these heavy metal to accumulate in the soil in large quantities and contaminate the soil, thereby posing a threat to human health through the food chain [14]. Incidents of heavy metal pollution in the soil occurred frequently during the development of mineral resources, especially heavy metal poisoning incidents caused by mining and metallurgical activities also occurred from time to time [14]. Chinese researchers Jia et al. (2018) evaluated heavy metal pollution in the soil of an iron mining area in Anshan City. Results shows that Cd and Ni in the soil exceeded the standards, and Pb, Cu and Zn did not exceed the limits but they also accumulated in the soil [15]. This shows that there are serious hidden dangers of heavy metal pollution to the soil in some mining areas in Anshan, which should arouse the attention of relevant departments. The main source of soil pollution is the tailings pond ore dressing waste water and solid waste after weathering and leaching. The harmful elements and soluble salts pass through the surface water and the infiltration of groundwater pollutes the soil. The more serious areas are the Gaoguanling-Jiubao Station-Lisantaizi zone and Chengangbao, Songsantaizi, Donganshan, Dagushan and other areas, the main pollutants are iron and manganese; The main pollution sources in Haicheng and Xiuyan are the dust pollution of soil caused by the deep processing of magnesite, talc and calcite and the land around the mining area is consolidated, resulting in crop loss [16].

2.3. Effects of Mineral Resources Exploitation on Air Pollution

Anshan City is rich in mineral resources and has large open-pit mining plants, such as: open-pit mining of Gushan Iron Mine, open-pit mining of Yanqianshan Iron Mine, open-pit mining of Qidashan Iron Mine, etc., plus other small mining areas with a total area of 5032.41 Hectares, statistics show that the area of severe particulate pollution area reached 3387.81 Hectares [17]. In addition, the Jiancheng District of Anshan City is surrounded by six mining areas. The distance and height between the mining area and the city are constantly approaching with the increase in mining volume, making the particulate pollution situation become more and more serious. At present, the iron ore mining area covers an area of 2195 hectares, the formed rock dump covers an area of 705 hectares, the amount of rock accumulation exceeds 2.5 billion tons, the tailings pond discharge exceeds 1.2 billion tons, and the pollution impact area exceeds 160 hectares. Moreover, the discharge of cupola flue gas in the smelting and sintering process of Angang Steel results in increasingly poor air quality. Using the Anshan City Air Pollution Source Emission List and the ADMS-Urban Model based on the analysis of the source of particulate pollutants in the ambient air in Anshan City, the research results show that the secondary dust from mines contributes to the concentration of particulate pollutants in the urban ambient air are. 16% and 14.4%, respectively [17].

Especially in recent years, the occurrence of haze weather has seriously affected people's health. The smog problem is an environmental problem urgently to be solved in Anshan City. In order to control the haze weather, the Anshan city government has done a lot of work, but it is far from enough to rely on the government to control air pollution [18].

According to the fact that air quality is a concern of most people, a simple questionnaire survey of 500 people in Anshan City was conducted to solve this problem. The statistical results are shown in Figure 1. Figure 1 indicates that only the people of 8% in Anshan City are satisfied with the local air quality, while the people of 45.01% think that the local air quality is extremely poor.

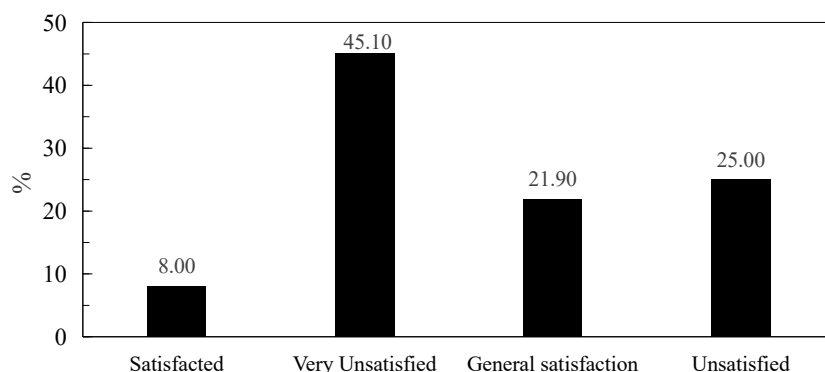


Figure 1. Current situation of people's satisfaction with air quality in Anshan City

Combined with the results of sample interviews with the elderly group, it is shown that the elderly group is extremely dissatisfied with the local air quality. Most people claim that the air quality has seriously affected their physical condition, especially in the winter when the weather is cold. Hospital medical staff also indicated that severe respiratory infections are caused by severe smog.

In an expert interview, it was pointed out that since China is still in the ranks of developing countries, the development of mineral resources and urbanization are still continuing and the cross-regional pollution of various regions is still continuing, our province must not actively engage in air quality construction. The surrounding provinces and cities are still going on their production plans and the air quality management must be a national plan with the participation of all people.

3. Countermeasure of Mineral Resources Exploitation

Based on a series of major environmental pollution problems such as water, soil and air currently faced by the "Steel Capital" city, a series of reasonable suggestions have been put forward for the current deficiencies in the development of mineral resources. Following the requirements of the sustainable development strategy, it should promote the "Green" business philosophy and propose a new "Green" business model for improving the current "Steel Capital" urban environment.

3.1. "Green" Shopping

"Steel Capital" mineral enterprise give priority to purchasing products that can reduce consumption, reduce emissions, save resources and can be recycled. Buyers should encourage suppliers to adopt advanced production technologies and processes as well as clean energy. The "Green" selection of suppliers for mineral resources development shaped products is conducive to cultivating green partners, ensuring that the product has a "Green" concept at the beginning of production and promoting the fulfillment of corporate social responsibilities.

3.2. "Green" Production

3.2.1. Strengthen the Online Monitoring and Processing Capacity of Enterprise

"Steel Capital" enterprises should devote themselves to building an efficient, unified and complete environmental protection information processing platform and information centralized control center, using video surveillance in the area to collect data on air quality, harmful gases, smoke and dust particles, etc., and performing corresponding data collection processing and evaluation, which in turn encourages companies to continuously improve their online monitoring and processing capabilities for pollution sources such as smoke, sulfur dioxide, and nitrogen oxides. This requires an accurate construction of an ecological mining

platform. The core part of this platform is to have a database management system and an ecological information system for the mineral resources of various mines in Anshan area (See Figure 2).

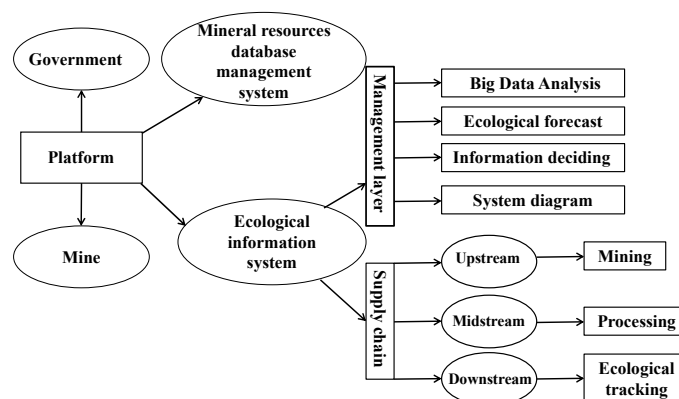


Figure 2. Structure diagram of ecological mine platform

According to these two systems, the government and enterprises can more intuitively grasp important information such as the amount of mineral resources in the area and the progress of the mine ecological construction. The ecological information system starts from two levels, management and supply chain. The ecological environment of various mines in Anshan has been analyzed and forecasted using system diagrams and other methods. At the same time, the development process of the ecological environment construction of various mines in Anshan was traced and tracked, which provided big data support and protection for the future development of the ecological environment for various mines [19].

3.2.2. Cleaner Mode of Production

The clean production method is very different from the traditional end-of-pipe treatment model. It does not take the ultimate goal of polluting waste discharge as the ultimate goal, but takes environmental protection as the goal of the enterprise and pursues “zero discharge” of pollutants in the production process. Companies adopting cleaner production methods pay more attention to the full control of production, not just focusing on whether the resources of a certain link are fully utilized. This method extends the company’s environmental pollution prevention and control from the inside to the outside, which makes up for the shortcomings of enterprises that only control internal pollution [20].

3.2.3. Innovate Technology and Process and Promote Energy Conservation and Emission Reduction

“Steel Capital” mining enterprises should continuously optimize innovative technologies, carry out system energy-saving transformations, adjust their energy structure, reduce their energy consumption, improve their energy efficiency, promote the diversification of energy supply, and achieve efficient and clean energy use [18,21]. At the same time, companies should increase their investment in air, soil and water pollution control facilities. However, enterprise also should participate in advanced environmental protection exchange meetings, seek cooperation and learn excellent experience from each other, accelerate the development of their own energy-saving and environmental protection technologies, which improves the overall energy-saving and environmental protection of the company level and promotes the gradual realization of the energy-saving and enterprises emission-reduction goals.

3.3. “Green” Marketing

3.3.1. Set up Green Marketing Concept

“Steel Capital” mining enterprises should change their original traditional marketing concepts, and should not only focus on the acquisition of their own interests, but should pay more

attention to the conservation of corporate resources and the protection of the environment. By coordinating the relationship among the three aspects of corporate interests, resource conservation and environmental protection, enterprises are encouraged to fully consider the actual situation in the development process, aiming to guide the future production and operation activities of enterprises by establishing new marketing concepts.

3.3.2. Design Green Products and Price them Reasonably

"Steel Capital" mineral enterprises must use green products as the carrier to achieve green marketing, use renewable resources as much as possible, reduce resource consumption, and eliminate or reduce the atmosphere pollution caused by the three wastes in the production and packaging process. In addition, enterprises treat and recycle waste as much as possible to make it a new resource. However, green products will inevitably increase the production cost of enterprises, but the increase in product prices is only temporary. With the improvement of environmental protection measures and people's environmental awareness increase, green product marketing can not only help enterprises make profits, but also help enterprises occupy more advantage competition.

3.3.3. "Green"Promotion

The "Steel Capital" mineral enterprise adopts some green marketing methods such as electronic marketing to advertise products to buyers. Explain and demonstrate the green functions of products for consumers, so that more buyers can understand the benefits of green marketing, which not only motivates consumers to buy products, but also prevents enterprises from polluting the overall environment during product promotion.

3.4. "Green" Education

"Steel Capital" mineral enterprises should frequently train their employees on the awareness of the "Green" concept and carry out a large number of "Green" concept training courses. The ultimate goal is to thoroughly require employees to understand the meaning of the "Green" business model. Therefore, all enterprises should take the initiative to assume the responsibility of environmental governance and strengthen environmental awareness. The environmental management of "Steel Capital" is a long-term and complex system engineering. In the process of governance in Anshan, the tasks of all enterprises are still very arduous, that is to say that all enterprises need to spend real efforts to complete them. At the same time, the cooperation and supervision of relevant government departments and the public are also needed to solve the environmental protection problems in Anshan City more effectively and faster.

4. Prospect

In view of the extremely serious pollution of water, soil and air caused by the development of mineral resources, this has brought great pressure on the country's environmental protection. Therefore, we should start from the individual, form a "Green" business philosophy, insist on building a "Green" industrial chain, and try our best to maintain "Green" sales, "Green" utilization, and "Green" recycling from product processing to use to recycling. Indirectly realize the ultimate goal of my country's sustainable development strategy step by step.

References

- [1] Zhu, Q., Yu, G. Adjustment of New Problems in Mineral Resources Exploitation by Environmental Law [J]. Mining Research and Development, 2014,34(02):63-67+88.(Chinese)
- [2] Naser, H. A. Assessment and Management of Heavy Metal Pollution in The Marine Environment of The Arw. Marine Pollution Bulletin, 2013, 72(1): 6-13.

- [3] Jiang, T. Discussion on The Influence of Mineral Exploitation on Environment and Its Management Strategy [J]. *Science and Technology Innovation Herald*, 2015, 12(21):140-141. (Chinese)
- [4] Fleury, A.-M., Davies, B. Sustainable Supply Chains—Minerals and Sustainable Development, Going Beyond the Mine. *Resources Policy*, 2012, 37(2):175–178.
- [5] Haldar, S. K. Environmental System Management of Mineral Resources and Sustainable Development. *Mineral Exploration*, 2013: 267–285.
- [6] Wen, X., Xin, C. A Brief Discussion on the Environmental Hazards and Recycling of Waste Batteries[J]. *China Collective Economy*, 2009, 7: 188-189. (Chinese)
- [7] Cen, W. The Influence of Mineral Resources Exploitation on Environment and Its Countermeasures [J]. *China High-Tech Enterprises*, 2014(23):128-129. (Chinese)
- [8] Sun, Z., Xie, X., Wang, P., Hu, Y., Cheng, H. Heavy Metal Pollution Caused By Small-scale Metal Ore Mining Activities: A Case Study From A Polymetallic Mine In South China. *Science of The Total Environment*, 2018, 639: 217–227.
- [9] Yu, W. Thoughts on Mineral Exploitation and Environmental Governance[J]. *World Nonferrous Metals*, 2019(13):201+203.(Chinese)
- [10] Adler Miserendino, R., Bergquist, B.A., Adler, S.E., Guimarães, J.R.D., Lees, P.S.J., Niquen, W., Velasquez-López, P.C., Veiga, M.M. Challenges To Measuring, Monitoring, and Addressing the Cumulative Impacts of Artisanal and Small-scale Gold Mining in Ecuador. *Res. Policy*, 2013, 38:713–722.
- [11] Gao, W., Li, Y. Environmental Effects for the Exploitation and Utilization of Mineral Resources: Spatial Pattern and Evolutionary Trend [J]. *Journal of Environmental Economics*, 2018, 3(01):76-93. (Chinese)
- [12] Zhang, D. Discussion on Hydrologic Environmental Condition Investigation of X Iron Mine in Anshan City[J]. *Public Communication of Science & Technology*, 2016, 8(09):161-162. (Chinese)
- [13] Cheng, H., Hu, Y., Luo, J., Xu, B., Zhao, J. Geochemical Processes Controlling Fate and Transport of Arsenic in Acid Mine Drainage (AMD) and Natural Systems. *J. Hazard. Mater.*, 2009, 165:13–26.
- [14] Pang, W., Qin, F., Lv, Y, et al. Chemical Speciations of Heavy Metals and Their Risk Assessment in Agricultural Soils in a Coal Mining Area From Xingren County, Guizhou Province, China [J]. *Chinese Journal of Applied Ecology*, 2016, 27(05):1468-1478.(Chinese)
- [15] Jia, L., Liu, P., Lv, L., et al. Pollutions Assessment of Heavy Metals in Soils Surrounding an Iron Mine Region in Anshan[J]. *Conservation and Utilization of Mineral Resources*, 2018(04):118-123. (Chinese)
- [16] Chen, L. On the Present Situation of Mineral Resources Exploitation Environment and the Construction of Ecological Civilization[J]. *Science and Technology Innovation Herald*, 2019, 16(03) :151-152. (Chinese)
- [17] Li, J. Investigation and Study on Distribution and Pollution of Mining Area in Anshan city [J]. *Shandong Industrial Technology*, 2016(12):274.(Chinese)
- [18] Zhou, Y., Zhu, X. Research on Countermeasures for Haze Control in Anshan City From the Perspective of Enterprises [J]. *China Market*, 2016(44):127+136. (Chinese)
- [19] Zhou, Y., Zhu, X., Wang, D. Study on the Construction of Anshan Ecological Mine Platform[J]. *China Market*, 2016(38):182-183. (Chinese)
- [20] Giannetti, B. F., Agostinho, F., Eras, J. J. C., Yang, Z., Almeida, C. M. V. B. Cleaner Production for Achieving the Sustainable Development Goals. *Journal of Cleaner Production*, 2020:122127.
- [21] Guo, X., Zhang, X., Yue, J., Zhu, K. A Case Study of the Key Factors and Mechanism Associated with Mining Site Pollution Control Based on An E-platform Management System. *International Biodeterioration & Biodegradation*, 2018, 128: 177–181.