

Evaluation and Countermeasures on sustainable development of nickel resources in China

Zhifeng Lin

Faculty of Land Resource Engineering, Kunming University of Science and Technology, Kunming 650093, China

Abstract: Nickel is an important strategic resource in China. With the gradual reduction of nickel re-sources and the increasing competition of the global mineral resources market, the safety of nickel resources in China has been seriously threatened. Therefore, it is very important to evaluate the sustainable development of nickel resources in China and put forward the corresponding countermeasures. In this paper, the concept and research situation of sustainable development are analyzed. Based on the specific development of nickel resources in China, this paper uses AHP to evaluate the safety of nickel resources in china. Finally, it puts forward the concrete measures to implement the sustainable development strategy of nickel resources in China.

1 General Instructions

Nickel is a silvery white metal, with stable chemical properties, strong corrosion resistance, high mechanical strength, good ductility and other metal synthesis special purpose alloy properties. It is widely used in the fields of machinery, construction, electrical, aviation, national defense and so on. As a result, nickel has become an indispensable strategic metal in modern society. Nickel is mainly used for stainless steel, non-ferrous metal alloy and special alloy, magnetic materials, ceramic pigment, anticorrosion coating, casting coins, electroplating, nickel cadmium battery, porous materials, catalyst and so on [1]. Due to the rapid increase in the amount of stainless steel in China, China is now the world's largest consumer of nickel, nickel resources with the development of economic growth. However, the demand for nickel resources in China is relatively large, which is a serious problem, which relies on import all year round. Nickel resources industry as the upstream industry, supply problems will seriously restrict the development of other industries. Faced with the grim situation of nickel resources, it is of great significance to study the sustainable development strategy of nickel industry and ensure the safety of nickel resources.

At present, China is vigorously implementing the strategy of sustainable development, which has been listed as the basic national policy of implementing sustainable development strategy by controlling population, protecting the environment, saving and rational use of natural resources. Chinese current nickel resources industry development model is transforming step by step to the sustainable development of industrial structure under the guidance of the policy. This paper starts with the concept, connotation and historical development of sustainable development. It also draws lessons from the sustainable development of international and other related industries. Then, according to the specific situation of nickel resources in China, the evaluation index system of sustainable development of nickel resources was established. Finally, according to the evaluation results, this paper puts forward the sustainable development strategy of nickel resources.



2 Research Progress of Nickel Resources Sustainable Development

In 1987, the World Commission on environment and Development released "our common future" for the first time, the concept of sustainable development is discussed in this paper: "not only meet the current needs, not for future generations the ability to meet the needs of economic development". The report pointed out that when the environmental problems increasingly serious has a negative impact on human development in the future, therefore, we need to get out of a can support future human progress, resource environment and coordinated economic and social development, the road of sustainable development [2]. This marks the birth of the concept of sustainable development. Since then, along with the continuous development of economic and social globalization, the requirements of sustainable development of countries have gradually reached a consensus. Sustainable development strategy in the continuous research and active exploration of human are developed, from the early qualitative research to the current quantitative analysis, and the theoretical discussion to the practical application of the development of [3].

Sustainable development is the development and utilization of nickel resources in the sustainable development of the application of research results to the nickel resource, is a product of the development of sustainable development theory to the practical application, it requires people in the development and utilization of nickel resource strategy in the process of development, it is necessary to consider the current development needs, but also consider the needs of future development, the the nickel resource development and utilization, economic development and social development and environmental protection coordination, to achieve a virtuous cycle of [4]. There are a lot of researches on the sustainable development of nickel resources in China, which was first discovered in the 90s of last century. The main research object is Jinchuan nickel mine.

Tan Shixiong [5] through the summary of Jinchuan nickel resources comprehensive utilization practice system, emphasizes the important significance to improve the comprehensive utilization of resources to realize the strategy of sustainable development and the profound influence to the enterprise economic transition, and unfavorable factors of international nickel industry on the development of the strategic measures are put forward to further improve the comprehensive utilization of nickel resources in Jinchuan the level of [5]. Huang [6] to the founding of the research on the beneficiation of Jinchuan nickel mine sustainable development, suggestions put forward [6] from lean development, reduce the content of MgO, improve the comprehensive utilization of serpentine nickel concentrate, copper recovery and PGE recovery etc.. Zhao Wuzhuang [7] on the development of China's nickel resources are summarized, put forward the strategic goal of the future development of nickel resources in China: the establishment of a domestic nickel resources strategic reserves reliable; positive control and grasp the overseas advantages of nickel resources, vigorously promote the development and utilization of mineral resources to achieve overseas nickel, nickel production and supply in China the international business [7]. Peng Liang, Li Jun [8] put forward 5 major measures: nickel resources sustainable development strategy and the production, the reasonable allocation of resources; strengthen the ore dilution and loss management; actively promote the nickel mine prospecting work; establish mineral resources reserves policy; accelerate the development of overseas mineral resources [8]. Chen Jiabin [9] on the nickel supply sustainable security put forward 6 priorities: continue to do a good job in the construction of Jinchuan nickel base, increase the proportion of investment policy, strengthen the exploration of nickel nickel deposit; increase the development and utilization of resources and technology research and development, improve the recovery rate of various useful metal; pay attention to the development of deep processed products of nickel, nickel products to adjust structure; strengthening the development of ocean bottom and overseas nickel resources; rationalize nickel resources import and export policies; vigorously develop the nickel stainless steel [9]. Wang Gongmin [10] put forward the way of sustainable development of nickel resources in China, and from the domestic and foreign markets in the two aspects of [10]. Zhang Jiadong (2013) of nickel resources in our country, the short-term and long-term safety evaluation model is established by using AHP, and puts forward the corresponding security measures, pointed out that the reasonable structure of China nickel resource supply should be based on the international market, mainly to buy overseas development aid; also by adding large do-

mestic exploration and development efforts to increase domestic supply capacity. Actively expand two times recycling and nickel supply a variety of ways such as security, nickel resource security, reduce the dependence on foreign [11]. Zeng Xiangting, Xu Hong et al. [12] through the research on the distribution and characteristics of the nickel ore of nickel resource market supply and demand, and puts forward some countermeasures for the sustainable development of nickel resources industry, i.e. increasing nickel exploration efforts, pay attention to the development of nickel resources abroad, strengthen international cooperation, realize the diversification of import channels, and optimize the traditional technology and the industrial structure adjustment, the development of nickel resources unique refining technology, improve the utilization of renewable resources of nickel [12]. Yang Zhiqiang, Wang Yongqian [13] on the basis of long-term in-depth understanding of the nickel resource market, put forward the circular economy and technology and system innovation simultaneously, improve the level of comprehensive utilization of mineral resources, the rational development of domestic resources, make full use of overseas resources, looking for new nickel ore resources, development, edge ore residual ore, lean ore, deep well and in situ leaching mining technology, improve the complex mining safety, high efficiency and economic development, vigorously develop the use of laterite ore etc. the sustainable development strategy [13].

Most of the early researches on the sustainable development of nickel resources are based on the geological prospecting and the comprehensive utilization of nickel resources. With the development of global resources and the shortage of nickel resources in China, it has become an important research object for the sustainable development of nickel resources. In recent years, the factors of environmental protection have been added to the research content. However, compared with other resources, the sustainable research of nickel resources is still not enough, and there is not a system, which is mainly based on qualitative research.

3 Nickel Resources Sustainable Evaluation System

3.1 Establishment of index system

There is a certain correlation between sustainable evaluation system and safety evaluation system, but the sustainable evaluation system is more focused on the details and subjective behavior, the basic objective factor of the domestic desalination resources cannot be changed into.

Based on the understanding of the concept of sustainable development, combined with previous research results, based on the availability of statistical data and nickel resources industry specific circumstances, establish the [14-17] system of sustainable evaluation of nickel resources in China by AHP, as shown in figure 1. The evaluation system is divided into three layers, the first layer is the target layer, the sustainable development of the nickel resources in China, the ultimate goal of evaluation system is analyzed through the comparison with other layers of the first layer; the second layer is the rule layer, namely the four direction of sustainable development of nickel resources, were factors of comprehensive utilization of resources, economic factors efficiency factors, environment factors, social benefits; the third layer is the index layer, the four direction corresponding to the criterion level, is divided into fourteen indexes.

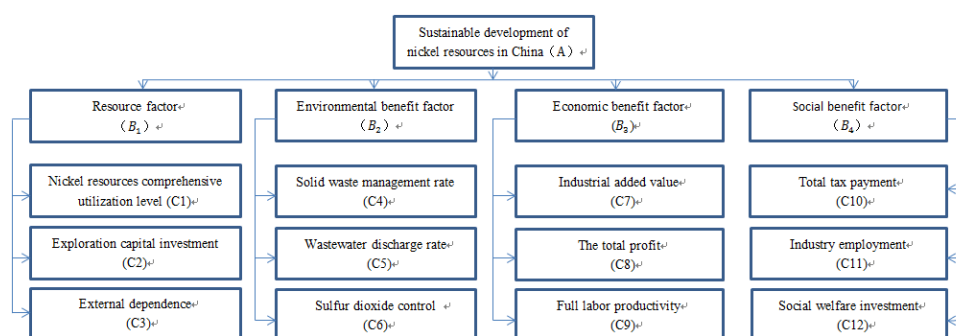


Figure 1. Evaluation index system for sustainable development of nickel resources in China.

3.2 Calculation of index weight

In this paper, AHP is used to determine the weight of sustainable development index of nickel resources in china. Analytic hierarchy process (AHP), referred to as AHP, is a multicriteria decision making method, which contains both qualitative and quantitative analysis. Analytic hierarchy process (AHP), through the in-depth study of the nature of the problem, to find out the influencing factors of the problem, and then establish a hierarchical structure. After the establishment of the hierarchy, the impact of 22 factors (often through expert scoring and questionnaire to determine), thus establishing a judgment matrix. The value of the judgment matrix is the ratio of the importance of each factor, often using the 1-9 scale and its inverse scaling method. On the basis of the judgment matrix, the weight is calculated. As the result of the judgment matrix needs to satisfy the consistency test, it is necessary to calculate the consistency index $CI = \frac{\lambda_{\max} - n}{n - 1}$, only when the consistency ratio $CR = \frac{CI}{RI} < 0.1$ to meet the consistency.

The weights of all levels are calculated by Excel software, as shown in Table 1 to table 5.

Table 1. Resource factor weight.

	C1	C2	C3	Weight
C1	1	5	1/6	0.188
C2	1/5	1	1/9	0.056
C3	6	9	1	0.756

Table 2. Environmental benefit factor weight.

	C4	C5	C6	Weight
C4	1	3	4	0.625
C5	1/3	1	2	0.238
C6	1/4	1/2	1	0.136

Table 3. Economic factor weight.

	C7	C8	C9	Weight
C7	1	1/4	1/3	0.122
C8	4	1	2	0.558
C9	3	1/2	1	0.320

Table 4. Social benefit factor weight.

	C10	C11	C12	Weight
C10	1	5	7	0.732
C11	1/5	1	1/4	0.082
C12	1/7	4	1	0.186

Table 5. The weights of four indexes of criterion layer.

	B1	B2	B3	B4	Weight
B1	1	6	4	5	0.614
B2	1/6	1	1/2	2/3	0.090
B3	1/4	2	1	1.5	0.173
B4	1/5	1.5	2/3	1	0.124

The results show that the resource is the most important factor in the sustainable development index system of nickel resources in China, and the second is the economic benefit, social benefit and en-

vironmental benefit. The 5 most important indexes in the index layer are the foreign dependency rate of governance, nickel resources comprehensive utilization level, total profit, total tax, solid waste.

4 Countermeasures for Sustainable Development of Nickel Resources in China

On the basis of sustainable development of the nickel resource evaluation system results, experience and practice in the strategy of sustainable development practices of the countries in the world, combining the actual conditions of our country and new challenges in the context of sustainable development, China can try to implement the following strategies to ensure the sustainable development of [18-20] nickel resources.

4.1 Stable supply of nickel and other mineral resources at home and abroad

Economic and social development needs to have a certain amount of mineral resources to protect, and our country has proven nickel and other mineral resources reserves have been unable to meet the needs of domestic production and consumption. Therefore, according to the national comprehensive, coordinated and sustainable development requirements, based on studying and using the advanced experience of other countries, combined with China's actual conditions and take effective measures, multi-channel access to further stabilize the domestic nickel resources, nickel and other mineral resources supply, to meet the needs of domestic economic development demand for nickel mineral resources.

4.2 Establish a correct sense of sustainable development

A new concept of the formation and widely recognized by the whole society is the need for a certain amount of time and process, and the concept of sustainable development in recent decades was put forward, and in 1996 at the national level was identified as the country's current and long-term development strategy. Therefore, to actively and effectively take a variety of ways for the concept of sustainable development in the whole nation in education, through the national education is to really establish the sustainable development in the ideological consciousness, not a waste of mineral resources in action.

4.3 Formulate laws to regulate people's behavior

Specifically, it is necessary to improve the laws and regulations of China's mineral resources and related policies, strengthen the management of mining rights approval work, in strict accordance with the statutory procedures and policies to carry out audit checks. To increase the mining rights market clean-up efforts, to those of mineral resources exploration, not only circle on behalf of mining exploration, illegal transfer of mining rights and other illegal processing and rectification in accordance with the law, implementation of mineral resource planning and orderly management. To cultivate and standardize the market of mining rights effectively configures the prospecting and mining rights through the market mechanism.

4.4 Make full use of the international and domestic two markets

The acquisition of mineral resources can be obtained either in the domestic market or in the international market. In order to obtain the needed resources for the enterprise first should be based on domestic market of mineral resources, take practical measures to further tap the potential of domestic mineral resources; secondly, should pay more attention to the development of the international market of mineral resources, take a variety of ways to obtain mineral resources in the international market. Persist in grasping the market, the two block two to promote the simultaneous development of the market, in order to occupy the market to get more mineral, mineral resources.

4.5 Improve the comprehensive utilization of mineral resources

Now there is a shortage of resources on the one hand, on the other hand, waste of resources is very serious. Therefore, we must do a good job in the development and utilization of resources, but also to do a good job of saving resources. The regeneration of nickel utilization in China compared to developed

countries is still relatively low, the extraction technology of tailings, ore, ore also needs to be improved. To this end, the state should vigorously strengthen scientific and technological research in this area, and strive to improve the level of resource utilization. In the specific operation, we should actively research, development, promotion of nickel ore products deep processing technology, development of new applications of nickel and other mineral resources utilization, improve the quality and structure of the product, in order to achieve the conservation of resources, reduce the cost and improve the efficiency and adaptability to the market. Also note that rely on scientific and technological progress to the development and utilization of lean ore, ore, ore, small residual ore and the outside of the mine, improve the level of utilization of resources.

4.6 Develop recycling economy and make full use of renewable resources

Circular economy is the inherent requirement of the country to take a new road to industrialization, and is an economic model with the core of efficient utilization and recycling of resources. Therefore, the national mineral resources and enterprises should improve the comprehensive utilization efficiency of nickel and other mineral resources at the same time, the waste materials and then used to increase the use of space nickel and other mineral resources, sustainable development and recycling of the new road to industrialization.

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5 Conclusions

The safety of nickel resources is closely related to the national economic and political security, and plays a more and more important role in the process of China's industrialization. The supply of nickel resources in China is insufficient, and the situation of dependence on foreign countries is grim. In the future, nickel resources in our country should adhere to the road of sustainable development, adhere to the road of deep processing, take the road of internationalization and modernization.

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