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Research on Ecological Compensation Value Measurement of a Coal Resource Development in Southeast Asia

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Abstract: The report of the 19th National Congress of the Communist Party of China pointed out that human and nature are the community of life, and humanity must respect, conform and protect nature. With the increasingly severe international situation, the domestic and international economic dual-cycle policy is proposed, and the concept of protection in opening up and development in protection is recognized by more people. In the process of mineral resource development, the significance of measuring and studying the value of ecological environment compensation is particularly important. Based on the study of predecessor's measurement models, this paper comprehensively considers the impact of mineral resource development on forests, grasslands, farmlands, wetlands, water bodies and deserts and other ecological and economic environmental factors to varying degrees, and constructs a system that can fully consider the value of ecosystem environmental losses. Comprehensive measurement model. The ecological environment compensation value comprehensive measurement model is applied to the practice of coal mine ecological environment compensation value measurement, the coal mine ecological environment compensation value is calculated, and the applicability of the ecological environment compensation value comprehensive evaluation model is verified to a certain extent.

Keywords: coal resources, development and utilization, ecological environment compensation value, measurement research

With the new situation and requirements, there is a new development pattern in which the domestic economic cycle is the main body and the domestic and international economic cycles promote each other. China's demand for mineral resources cannot rely on the domestic and foreign markets as in the past few decades, but should rely more on the domestic market. Although the global economy is weakened by the epidemic, China's economy is huge, its demand for mineral products still has a large increase, and its dependence on foreign mineral resources is still high. Mineral resources will continue to be an important factor affecting China's economic and social development. Since China 's industrialization is and will remain at the primary level for a long time, its typical characteristics are high energy consumption and low output. In order to find a balance between economic development and the development and utilization of mineral resources, that is, to exchange the lowest environmental cost for the greatest economic benefit, relevant government departments and scientific research personnel have evaluated the ecological environment and carried out many in-depth and detailed explorations and practices. Explore ways to alleviate the contradictions and conflicts between economic and social development and the adverse effects on the ecological environment caused by the development and utilization of mineral resources.

The ecological environment compensation value measurement model is a quantitative model that studies the impact of mineral resources on the ecological environment during the development and utilization of mineral resources. This paper explores the theory and methods of ecological environment compensation for the development of mineral resources, taking a coal mine in Southeast Asia as an example, comprehensively considering various factors affecting the ecological environment such as forests, grasslands, farmland, wetlands, water bodies, and deserts, to study the development and utilization of mineral resources In the process, functional loss of the ecological environment, environmental pollution, and adverse effects on the health of local residents and future development opportunities[1].

1 Eco-environmental compensation value measurement model

As the country's environmental protection requirements for the development and utilization of mineral resources are increasing, the research on the value of ecological environment compensation has attracted more attention from scholars. In- depth analysis of the development status and problems of the ecological environment compensation value measurement research of mineral resource development can better promote the development of the ecological environment compensation value measurement research work of mineral resources development.

Mineral resource development of ecological compensation value measurement model, that is developing a number of environmental factors in the development and utilization of mineral resources to influence the extent of the ecological environment quantitative model, select focus, and adopt appropriate measurement methods for quantitative research. The development and utilization of mineral resources have a wide range of impacts on the ecological environment, including but not limited to forests, grasslands, farmland, wetlands, water bodies, deserts and other ecological environmental factors[2]. In specific practice, necessary environmental factors should be selected based on actual conditions to measure the value of ecological environment compensation. The methods of measuring the loss value of ecological environmental factors include but are not limited to the market value method, loss compensation method, human capital method, opportunity cost method, replacement cost method, shadow engineering method, substitution cost method and other existing measurement methods.

1.1 Comparative analysis of existing eco-environmental compensation value measurement models

In the practice of eco-environmental compensation for the development and utilization of mineral resources, there is an obvious lag, and the measurement results lack comprehensiveness.This article aims to establish a comprehensive measurement model of the ecological environment compensation value of mineral resources development, to overcome the lag and one-sidedness of ecological environment compensation, so as to make ecological environment compensation more widely applicable in practice.

Due to its special natural endowment, the ecological environmental compensation value of mineral resources development involves various theoretical foundations such as geological resources science, accounting and resource protection law, and there are too many measurement methods developed from theoretical foundations[3]. According to the differences in the geological attributes, mining and utilization stages of mineral resources, the selected measurement methods are also different due to their actual conditions. According to the general principles of asset evaluation, there are three main theoretical evaluation methods, namely the basic asset method (cost method), the comparable transaction method (market method) and the discounted expected return method (income method). Fundamental asset method (cost method) is a method oriented to the past, and the value is measured by reasonable input costs; comparable transaction method (market method) is a method oriented to the present, which measures value through the adjustment of key parameters of comparable objects[4] ; The discounted expected income method (income method) is a future-oriented method that measures the value by summarizing the discounted present value of the expected income that can be realized in the future.

The existing eco-environmental compensation value measurement model has further developed a variety of evaluation methods based on the basic evaluation theories and methods for the evaluation of the eco-environmental compensation value[5]. Including but not limited to market value method, loss compensation method, human capital method, opportunity cost method, replacement cost method, shadow engineering method and substitution cost method.

1.1.1 Market value method

The market value method calculates the output value per unit area of a certain ecological factor in the same area or similar areas, and adjusts comparable factors to indirectly estimate the value of the loss caused by the destruction of the ecological environment. The market value method is suitable for the measurement and evaluation of ecological environmental factors that can directly calculate the market price, that is, the ecological environmental factors have obvious and specific actual output products, and there is an active trading market for such products, and the transaction price can be accurately Obtain[6]. For some ecological environmental factors that have no obvious output, the market transaction method is difficult to measure and evaluate. In addition, this method only measures the direct value of ecological environmental factors, while ignoring its indirect value. In the end, the evaluation value of ecological environmental factors will be low, which cannot truly reflect the full value of certain ecological environmental factors.

1.1.2 Loss compensation method

The Loss Compensation Law is aimed at the damage to the ecological environment caused by the discharge of waste water, waste gas and waste during the development and utilization of mineral resources. The government levies environmental pollution discharge fees and internalizes the external costs of mineral resource development to standardize the behavior of developers. The value of the loss of ecological environment pollution is indirectly measured by the pollution fee. The Loss Compensation Law is only applicable to the situation where the national government has relevant regulations to impose a pollutant discharge fee on the discharge of certain pollutants[7]. If there is no relevant regulation, it cannot be measured and assessed. This method only measures the adverse effects of certain pollutants on the ecological environment, and can only be used as part of the evaluation value of certain ecological environmental factors.

1.1.3 Human Capital Law

The measurement of the loss of human capital mainly includes the economic value of the threat to the health of residents and the loss of development opportunities. The economic loss of residents' health threatened (disease incidence differences and treatment costs)[8]. It is calculated indirectly through health and medical expenses. The value of the loss of development opportunity cost is a discount of future income forecast, which is measured by the wage difference method. The wage gap method is only an indirect approximate estimation method of human capital, and it depends on the accuracy of local statistical data[9].

1.1.4 Opportunity Cost Method

Opportunity cost method refers to the use of ecological environment factors for specific purposes, and the largest value of other purposes abandoned. The eco-environmental factors evaluated by this method must have multiple uses other than the specific use, and the value generated by other uses can be easily measured and evaluated. If a certain ecological factor has only one specific purpose, then the ecological factor cannot be measured and evaluated using the opportunity cost method.

1.1.5 Replacement cost method

The principle of the replacement cost method is similar to that of the cost method in the evaluation of mining rights. The replacement cost method is a method of indirectly measuring and evaluating the value of ecological environmental factors by measuring the cost of restoring certain ecological environmental factors. This method is suitable for environmental and ecological factors that can restore their ecological and environmental effects through artificial means, but not for those that are scarce or have irreversible characteristics[10].

1.1.6 Shadow Engineering Law

The shadow engineering method is similar to the replacement cost method. It uses the cost of constructing a shadow replacement project to estimate the cost of restoring a certain ecological environment factor to indirectly measure the value of a certain ecological environment factor. This method is suitable for the environmental effects of certain environmental ecological factors, and can be restored by artificial means to construct a shadow project. For those scarce or irreversible ecological environmental factors, the shadow element engineering law does not apply[11].

1.1.7 Alternative cost method

Alternative cost method, that is, the cost of existing substitutes is used to evaluate and measure the value of ecological environmental factors. This method is suitable for a certain ecological environment factor that can find a substitute in the market, and its effect is as close as possible to the ecological environment effect of the ecological environment factor, and the price is the lowest.

This section systematically analyzes the basic theories and methods of eco-environmental compensation value, elaborates the basic theories of eco-environmental compensation, and comprehensively analyzes the correlation of eco-environmental compensation value in geology, accounting, and mineral resources law. Theory, in-depth and detailed introduction of market value method, loss compensation method and human capital method and other evaluation methods. The establishment of a comprehensive measurement model of ecological environment compensation value provides a certain theoretical research and analysis basis[12].

1.2 Establish a comprehensive measurement model of ecological environmental compensation value

By comprehensively considering the various influencing factors involved in the development and utilization of mineral resources, starting from the cost-benefit analysis method, using a variety of methods to measure the ecological environment compensation value in the development and utilization of mineral resources, including but not limited to market value Comprehensive loss compensation methods such as opportunity cost method and replacement cost method.

The comprehensive economic loss compensation method can be further detailed as an environmental cost-benefit analysis method, which calculates the value of different ecological protection environmental damages through various indicators, which reduces the difficulty of calculation and policy formulation. On the basis of the value loss of various ecological environmental factors in the development of comprehensive mineral resources, the comprehensive loss compensation method is adopted to compensate the ecological environmental loss of the mine[10].

Through the measurement research on the ecological environment compensation value in the development and utilization of mineral resources, a comprehensive measurement model of the ecological environment compensation value for the development of mineral resources with wide applicability is constructed.

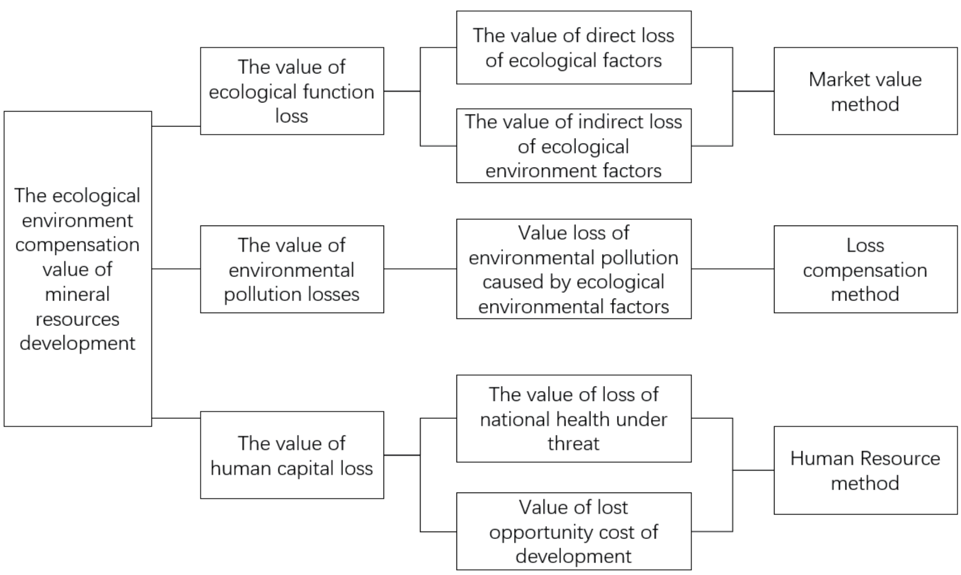

Figure 1-1 Schematic diagram of the process of constructing a measurement model

The comprehensive measurement model of ecological environment compensation value is based on the following basic assumptions:

Hypothesis1: During the development and utilization of mineral resources, it will cause functional loss, environmental pollution, and adverse effects on the health of the local population and future development opportunities for the ecological environment ;

Hypothesis2: The measurement of the functional loss of the ecological economic environment includes the direct use value loss, indirect use value loss of various ecological environmental resources, and the governance cost to restore the ecological environment;

Hypothesis3: The environmental pollution loss measurement "three wastes" discharge is the target, and the ecological environmental pollution loss value is indirectly measured by the pollution fee.

which is,

$$V_H = (A+B+C)\bullet F = [\sum_{i=1}^{n}[\varpi_i(a_i+b_i)+\beta_i c_i]+\sum_{i=1}^{n}\lambda_i d_i+(\rho\bullet e+\gamma\bullet f)]\bullet F$$

among them:

V_H – The Ecological Compensation Value of the Development and Utilization of Mineral Resources;

A – The value of ecological function loss; B – The value of environmental pollution losses;

C – The value of adversely affecting the health of local residents and future development opportunities;

F – According to the local economic development level;

n – The total number of different ecological environment factors with losses;

a_i – The value of the direct loss of the i - th ecological environment factor;

b_i – The value of the indirect loss of the i - th ecological environment factor;

ϖ_i – Assign the weight to the i - th ecological environment factor according to the degree of damage;

c_i – Restoration value of the i - th ecological environment factor;

β_i – According to the difficulty of restoration, assign the proportion of direct loss of the i - th ecological environment factor;

d_i – The value of the environmental pollution loss of the i - th ecological environmental factor;

λ_i – Assign the weight of the i - th ecological environment factor according to the degree of pollution;

e – Compensation for economic loss of residents?health threatened;

ρ – Percentage of economic losses that are threatened to residents?health;

f – Compensation value for residents' development opportunities adversely affected;

γ – Proportion of development opportunity cost compensation。

2 Overview of regional geological environment

The mining area is located in Mara, South Sumatra Province, Indonesia, Southeast Asia, more than 180 kilometers away from the West Sumatra Volcanic Seismic Belt, and is slightly affected by volcanic seismic activity. The landform of the mining area is a gentle slope-like hilly landform. The vegetation and forests in the area are lush, mostly artificial rubber forests. The general topography trend is high in the south and low in the north, with little undulation. The ground elevation is between 10 and 58m. According to the survey, there are no large surface ridges and steep rock masses in the survey area. Although the rainfall in the rainy season area is rapid and large, it will not cause soil erosion and mud-rock flow and other geological disasters in its natural state, but clay and mudstone are easy to soften when exposed to water, It is easy to form muddy phenomenon. Therefore, the clay, mudstone and sandy mudstone in this area are not easy to be directly used as the natural supporting layer of the open-air industrial square and infrastructure[13]. The coal corridor, the exit ditch and the step pavement in the pit should be laid A certain thickness of gravel soil material to prevent muddy roads. The vegetation and forests in the survey area are lush, mainly rubber forests, and the quality of the regional ecological environment is good. Due to the high rainfall in the region, the regional soil erosion is dominated by water erosion.

Ore zone-like landscape of gentle hills, lush vegetation and trees, little topographic relief. There are no large surface ridges and steep rock masses, and no geological disasters such as mudslides have occurred. After open-pit coal mining, extreme geological disasters such as landslides, landslides, and slabs may occur in the open-pit during the rainy season[13]. There are no special environmentally sensitive targets in the area, such as nature reserves, scenic tourism, cultural relics, and water sources.

3 Ecological environment compensation value measurement of coal mine development

In this section, the comprehensive measurement model of the ecological economic environmental compensation value of mineral resources development is applied to the specific practice of mineral resource development and utilization, and the environmental impact factors of the ecosystem are selected according to the actual situation, and the ecological social environmental compensation value comprehensive measurement method is used to calculate the ecological Environmental compensation value.

3.1 The value of ecological environment function loss

Loss of function of the value of the ecological environment, including ecological environment due to factors direct loss of value and ecological environment due to factors indirect loss of value.

3.1.1 Ecological environmental factors directly lose value

The direct loss value of eco-environmental factors is measured by the market value method, and the area occupied by the eco- environment factor through the development of mineral resources is multiplied by the corresponding output value per unit area. The output value of an ecological factor per unit area is calculated indirectly through the contribution of the ecological factor to GDP, divided by the land area occupied by the ecological factor.

The area is covered by dense jungle. When the open-pit mine reaches its production capacity (3.0Mt/a), it covers an area of 175.89 hectares (hm2), all of which are forest land. Therefore, when measuring the ecological environmental compensation value of mineral resource development, only consider the value of forest as an ecological environmental factor. To calculate the value of forest ecological environment factors, it is necessary to obtain the area of the ecological environment factor that is occupied by the development of mineral resources. When the area of production facilities Main Site List Table 3 -1.

Serial number	Item	Area (hm2)	Remarks
1	Quarry	94.32	
2	Outer dump	50.80	
3	Ground production system	1.50	
4	Industrial site	7.26	Occupying land within the wall
5	Ground road	11.06	
6	Water supply line	2.85	
7	power supply circuit	0.40	
8	Drainage and drainage works	7.70	
	Total	175.89	

Table 3 -1 List of the area occupied by each main site and facility when it reaches production capacity (according

to the feasibility study report of a coal mine project)

The direct loss of the ecological environment is based on the World Bank's 2017 statistics on Indonesia. In 2017, Indonesia's forest rent as a percentage of GDP was 0.4893%. In that year, Indonesia's GDP (current US dollars) was US$101,553,901,7536.5, and the forest area was 903,256.015,625 square kilometers. Relevant exchange rates: 1 US dollar = 6.7427 yuan (RMB); 1 square kilometer (square kilometer) = 100 hectares (hm2). Therefore, the average value of forest ecological environment factors in 2017:

(1015539017536.5×0.4893%×6.7744) ÷ (903256.015625×100)=3726.79 yuan/ha

Direct losses caused by the destruction of forest ecological environment factors:

=175.89×372.679 =655.5 thousand yuan

That is, in the process of coal mine development, the forest ecological environmental factors were destroyed, and the direct loss of the ecological environment caused by this was 655,500 yuan.

3.1.2 Eco-environmental factors indirectly lose value

The indirect loss value of ecological environmental factors is not as specific and clear as the direct value of ecological environmental factors. Due to its particularity, it is very difficult to evaluate the indirect loss value of ecological environmental factors. This paper uses the previous research results of ecological service value per unit area of ecosystem to indirectly calculate the indirect loss value of ecological environment factors. The indirect loss value of ecological environment factors is obtained by multiplying the area occupied by the ecological factors by the development of mineral resources by the corresponding unit ecological service value. Regarding the measurement of the unit ecological service value of ecological environment factors, the reference unit ecological service value can refer to the "Ecological Service Value per Unit Area of Different Terrestrial Ecosystems in China" (Xie Gaodi, 2013), Table 3-2.

	forest	Grass	farmland	wetlands	Water body	desert
Gas regulation	3097	707.9	442.4	1592.7	0	0
Climate regulation	2389.1	796.4	787.5	15130.9	407	0
Water conservation	2,831.5	707.9	530.9	13715.2	18033.2	26.5
Soil formation and protection	3,450.9	1725.5	1291.9	1513.1	8.8	17.7
Waste disposal	1159.2	1159.2	1451.2	16086.6	16086.6	8.8
Biodiversity	2884.6	964.5	628.2	2212.2	2203.3	300.8
Food production	88.5	265.5	884.9	265.5	88.5	8.8
Raw materials	2300.6	44.2	88.5	61.9	8.8	0
Entertainment culture	1132.6	35.4	8.8	4910.9	3,840.2	8.8
total	19334	6406.5	6114.3	55489	40676.4	371.4

Table 3 -2 Annual average ecological service value per unit area of different terrestrial ecosystems in China (yuan/ha) (According to Xie Gaodi, 2013)

The direct loss value of forest ecological environment damage:

=175.89 × 19334=3.4007 million yuan

That is, in the process of coal mine development, the local forest ecological environment factors were destroyed, and the indirect loss value of the ecological environment caused by this was 3.4407 million yuan.

3.2 The value of ecological environment pollution loss

Environmental pollution loss measures the discharge of "three wastes", and the value of ecological environmental pollution loss is indirectly measured through pollution charges. With the construction and development of open-pit coal mines, there will be some pollution to the surrounding land resources, water resources and the environment. According to the environmental analysis of the current mining area, the following main sources of pollution and pollutants will be involved in open-pit development in the future. There is no industrial site boiler room in this project. The bathing hot water in the bathroom is heated by solar and electric boiler auxiliary equipment, and no coal-burning pollution sources and pollutants are generated. The source of environmental air pollution is mainly the dust generated during the production process of the open-pit mine excavation site; the road dust caused by the traffic of road vehicles on the industrial site and off-site.

The sources of water pollution in industrial sites are mainly domestic sewage generated by living welfare facilities such as canteens, bathrooms, and dormitories, and industrial waste-water generated by car washes. The living drainage of the canteen passes through the grease trap and is connected to other drainage with the outdoor living drainage network. After being collected by the outdoor domestic drainage pipe network, it enters the domestic sewage treatment system.

Sewage is collected through the drainage pipe network and then enters the domestic sewage treatment system. The domestic sewage treatment room is equipped with a set of domestic sewage treatment equipment with a processing capacity of 10 cubic meters per hour. The treatment process is biochemical treatment, filtration and disinfection. Its core equipment adopts integrated sewage treatment equipment; the treated domestic sewage enters the clean water tank to be reused in open-pit mine greening water or mine road dust control sprinkler.

The environmental pollution loss value is evaluated and measured by the loss compensation method. The Loss Compensation Law refers to the damage to the ecological environment caused by the discharge of waste water, waste gas and waste during the development and utilization of mineral resources, and the government levies environmental pollution discharge fees. The value of the ecological environment pollution loss is indirectly measured by the pollution discharge fee, that is, a pollutant discharge fee = pollutant discharge (kg) / pollution equivalent value (kg) * charging standard.

The total amount of domestic sewage and production waste-water produced by the replication open-pit mine is 184.3 m3/d. Among them, the self-operated part of the domestic sewage is 37.27m3/d;the part of the domestic sewage from the external commission is 147.03m3/d (including 89.00 m3/d of oily sewage).

See Table 4-3 for Water Quality Indexes for various sewage water quality indicators produced by open-pit mines.

Serial number	project	Domestic drainage	Oily sewage	Open-pit mine Drain the water	Open-pit mine Drainage in the pit	Remarks
1	PH	-	-	5.50	-	
2	SS	200mg/L	300mg/L	5 ~10mg/L	300~1000 mg/L	
3	BOD5	150mg/L	-	-	-	
4	COD	300mg/L	200mg/L	-	300 mg/L	
5	NH3-N	20mg/L	-	-	-	
6	Suspended oil	-	60mg/L	-	20 mg/L	

Table 3-3 Water quality index table (according to the project feasibility study report)

The total investment in the sewage treatment system reached 797,800 yuan, and the construction of domestic sewage treatment, washing workshop sewage treatment, and mine water and drain water treatment equipment.

The solid wastes are mainly stripped objects and household garbage generated during open-pit mining. The second year of project construction is the production year. In the second year of production, the project starts to discharge. The annual discharge amount for the 20 years before the project reaches production is shown in Table 3-4.

Environmental air pollution prevention and control costs are mainly for dust pollution during the development and utilization of mineral resources, and 25t sprinklers are used to reduce dust on roads and working faces. The monthly operation and maintenance cost of the sprinkler is 10,000 yuan, and the development cycle of the project is 20 years.

Environmental air pollution prevention and control fee = 10000×20×10 = 200 (ten thousand yuan)

Sewage treatment costs include domestic sewage treatment, washing workshop sewage treatment, mine water and drain water treatment. According to the environmental protection project investment estimate, the operation and maintenance cost budget of sewage equipment, the sewage treatment cost is indirectly calculated.

Sewage treatment cost =67.63+12.15=79.78 (ten thousand yuan)

Production period	Outer dump (Mm^3)	Internal dump (Mm^3)	Total (Mm^3)	Accumulation (Mm^3)
Infrastructure period	0.7	-	0.7	0.7
The first year of production	3.3	-	3.3	4
2nd year of production	2.8	0.5	3.3	7.3
3rd year of production	0.5	2.8	3.3	10.6
4th year of production		3.3	3.3	13.9
5th year of production		4.44	4.44	18.34
6th year of production		4.44	4.44	22.78
7th year of production		4.44	4.44	27.22
8th year of production		4.44	4.44	31.66
9th year of production		4.44	4.44	36.1
10th year of production		4.44	4.44	40.54
11th year of production		4.44	4.44	44.98
12th year of production		4.44	4.44	49.42
13th year of production		4.44	4.44	53.86
14th year of production		4.44	4.44	58.3
15th year of production		4.44	4.44	62.74
16th year of production		4.23	4.23	66.97
17th year of production		4.23	4.23	71.2
18th year of production		4.23	4.23	75.43
19th year of production		4.23	4.23	79.66
20th year of production		4.35	4.35	84.01
total	7.3	76.71	84.01	

Table 3-4 Annual Disposal Amount Table 20 Years Before Production (According to Project Feasibility Study Report)

3.3 The value of ecological environment restoration

Regarding the restoration cost of the ecological environment, it is measured by the shadow project method, replacement cost method, and substitution cost method. You can refer to the environmental protection project investment estimate in the feasibility study report of the mineral development project. The shadow element engineering method, that is, the investment cost of artificially constructing a replacement shadow element project to estimate the restoration cost of the ecological environment. For example, the construction of artificial lakes to replace the water storage function of the polluted natural lake, but the disadvantage is that only the value of the limited water storage function is measured, and other values are not measured. The replacement cost method, which measures the cost of restoring or protecting the ecological environment from damage, is the lowest value. The key to the alternative cost method is to find a substitute with the lowest cost that can satisfy the ecological environment[14].

The cost of water and soil conservation measures during the construction period of the open-pit mine is 6.25 million yuan. See Table 4-6 for details. In addition, compensation for water and soil conservation facilities was 1.98 million yuan.

Serial number	Project or cost name	Construction and installation engineering costs	Plant measures		total
			Planting fee	Seedling fee	
1	The first sub-project measures applied	309.00			309.00
2	Part Two Plant Measures		63.00	153.00	216.00
3	Part III Temporary Works	100.00			100.00
Water and soil conservation measures fee					625.00

Table 3-5 Expenses of soil and water conservation measures during the construction period (unit: ten thousand yuan)

The total investment amount of the construction project is 380,178,800 yuan, and environmental protection investment accounts for 2.91% of the total investment, which is 11,047,800 yuan. Mainly include environmental air pollution control, sewage treatment, greening, water and soil conservation and other expenses.

Type of pollution source	Environmental protection facilities	Estimated investment (ten thousand yuan)	Remarks
dust	25t water truck	200	Dust reduction on roads and working faces
	Subtotal	200	
Pollution, waste-water	Sewage treatment system	79.78	Domestic sewage treatment Washing workshop sewage treatment Mine water and drain water treatment
	Subtotal	79.78	
Solid Waste	Crawler bulldozer	200	Dumping works
	Subtotal	200	
Ecological restoration	Soil and water conservation measures	625	Soil and water conservation
	Subtotal	625	
total		1104.78	
The proportion of environmental protection investment in engineering investment		2.91%	

Table 3-6 List of Investment Estimates for Environmental Protection Projects

3.4 The value of human capital loss

During the development and utilization of mineral resources, many kinds of damage are caused to the ecological and economic environment, such as water pollution, air pollution, and soil pollution[15]. While causing economic losses, it also has a major negative impact on the lives and health of local residents in the mining area. The value measurement of human capital loss mainly includes the economic value of threatened residents' health and loss of development opportunities. The economic loss of residents'health threatened (disease incidence differences and treatment costs).

3 .4.1 the health of residents threatened by the loss of value

Occupational safety and health in mining areas include the purchase of labor insurance supplies, protective equipment, and regular occupational health education on safe production. Except for the staff in the mining area, no other residents live near the mining area. The designed production capacity of this project is 3.0Mt/a, and the total number of registered personnel in the mine is 75. The annual working days after the open-pit mine is completed are 330 days. In addition to the above-mentioned self-employed personnel, according to design estimates, 220 outsourced production personnel are required. The total period of the second phase is 20 years, the construction period is 1 year, and the production period will increase the employment of 220 people[16]. From January to October 2018, the health / medical expenses of the mining area were 21,071.53 yuan.

The value of residents' health threatened loss is calculated indirectly through health and medical expenses. First calculate the unit health and medical expenses required per person per month, multiply by the number of people, and then multiply by the number of months. The total amount of health and medical expenses required.

Unit health and medical expenses =21071.53 ÷ 75 ÷ 10=28.095 (yuan)

The value of the loss of residents' health under threat = 28.095×(75+220)× 20 ×12 = 19.891 (ten thousand yuan)

3.4.2 worth the cost of lost development opportunities

The value of loss of development opportunity cost is a discount of future income forecast, which has great uncertainty. The future is always the development and evolution of the current situation, so the expected future benefits are indirectly estimated through the measurement of current income[17]. The value of development opportunity cost loss is measured by the wage differential method.

which is, $P = (Q - q_1) * n$

Among them, P is the loss of development opportunity cost, q1 is the average annual income of residents in the area where the coal mine is located, Q is the average annual income of residents in the same area, and n is the number of permanent residents in the mining area.

The designed production capacity of this project is 3.0Mt/a, and the total number of registered personnel in the mine is 75. The annual working day is 330 days after the open-pit mine is completed. In addition to the above-mentioned self-employed personnel, according to design estimates, 220 external commissioned production personnel are required[18]. From January to October 2018, there were 75 registered employees with a total salary of 1.21 million yuan. The total period of the second phase is 20 years, the construction period is 1 year, and the production period will increase the employment of 220 people. In 2017, Indonesia's per capita adjusted net national income (present value in U.S. dollars) was 2,817 U.S. dollars. In exchange rate conversion, 1 U.S. dollar = 6.7744 yuan (RMB).

Monthly salary of employees in the mining area = 1210000 ÷ 75 ÷ 10=8067 yuan

Indonesian monthly national income per capita =2817 × 6.7744 ÷ 12=1590.3 yuan

Since the wages of workers in mining areas are much higher than Indonesia's per capita national income, the loss of development opportunity costs can be ignored.

In summary, the value measurement of human capital loss mainly includes the economic value of threatened residents' health and loss of development opportunities.

The value of the loss of human capital C = the value of the loss of the health of the residents + the value of the loss of the development opportunity cost

=198.91 (ten thousand yuan)

3.5 Final calculation results

In the mine development process, destroy the local ecological environment of forest resources, the resulting loss was 65.55 million yuan, the indirect damage caused by the loss is 3.4007 million yuan. Environmental protection investment of 11.0478 million yuan, including ambient air pollution control, waste water treatment, green vegetation to fees and soil and water conservation. Among them, the cost of water and soil conservation measures was 6.25 million yuan. In 2017, Indonesia's per capita GDP was 26,0693.0964 yuan, while China's per capita GDP was 579863.4264 yuan during the same period .

$$V_H = (A + B + C) \bullet F$$

$$= (65.55 + 340.07 + 1104.78 + 198.91) \times \frac{260693.0964}{579863.4264}$$

=768.47 (ten thousand yuan)

This chapter applies the comprehensive measurement model of the ecological environmental compensation value of mineral resources development to the measurement practice of the ecological environmental compensation value of coal mines, and calculates the ecological environmental compensation value of coal mines. To a certain extent, the applicability of the comprehensive evaluation model of ecological environment compensation value is verified. In practical applications[19], the comprehensive evaluation model of ecological environmental value should be adjusted according to the actual situation of the evaluation object, so that the evaluation result is closer to the real value and accepted by more people.

4 Conclusions and prospects

(1) Through an in-depth analysis of the current status and problems of the ecological environment compensation practice in the development of mineral resources, this article compares the previous eco-economic environment compensation value measurement analysis models and methods, and points out that the research on the ecological environment compensation value measurement is lagging and one-sided. The problem provides a reference direction for establishing a comprehensive measurement model of the ecological environment compensation value of mineral resources development.

(2)Through the exploration of theories and methods of ecological environment compensation for the development of mineral resources, this paper takes a coal mine in Southeast Asia as an example, comprehensively considers forests, grasslands, farmland, wetlands, water bodies and deserts and other factors affecting the ecological environment to study mineral resources In the process of development and utilization, the functional loss of the ecological environment, environmental pollution, and adverse effects on the health of local residents and future development opportunities. To a certain extent, the applicability of the comprehensive evaluation model of ecological environment compensation value is verified.

(3) The direction of further research, namely, the necessity and rationality of accounting for the value of ecological environment compensation into the overall value of mineral resources, has reached a relatively unanimous opinion. However, there is no clear consensus on which ecological environmental factors are included in the ecological environment compensation value, and how to accurately measure and evaluate the value of these ecological environmental factors. This article only discusses a limited number of ecological environmental factors, and proposes a limited number of measurement methods. In terms of identifying ecological environmental factors and how to accurately measure them, further research work is needed to refine them to make them more widely applicable.

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