The Influence and Integrated Governance Planning of Coal Mining Subsidence Areas in Hegang City

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Abstract. In this paper, the impact of coal mining subsidence on geological ecology, road traffic, shantytown renovation and industrial park production and construction is analyzed. With the goal of promoting economic development, ensuring farmers’ income and improving the ecological environment, the three innovative concepts of economic engine, people’s livelihood security, and urban green lungs' comprehensive management plan for coal mining subsidence area are put forward. On this basis, the zoning integrated governance planning strategy of “one corridor and four districts” is expounded, namely, ecological cycle industry corridor, sightseeing and tourism area, ecological agriculture area, modern industrial area and landscape leisure area. The implementation measures of integrated control programming are discussed from the aspects of state funds or policy support and corporate performance obligations, in order to provide reference for the integrated governance planning of coal mining subsidence in Hegang city.

1. Introduction

The National Mineral Resources Planning (2016-2020) clearly pointed out that it is necessary to increase the governance of geological and environmental problems in historically-remaining mines and implement major projects in order to solve the outstanding geological environment of mines that seriously affect human settlements, industrial and agricultural production, and urban development. At the same time, the land use policy should be improved, and diversified investment should be encouraged to carry out the geological environmental problems of historically left mines[1].

The area of China’s coal mining subsidence area is expected to exceed 60,000 km², of which the area of urban-rural construction land and cultivated land overlap is 4,500 km² and 26,000 km², respectively, involving a population of about 20 million[2]. A large number of coal mining subsidence areas in coal cities are difficult to use, and they are idle and abandoned, resulting in the lack of intensive and effective use of land, which seriously restricts the sustainable development of coal cities. Therefore, it is very necessary to carry out comprehensive management planning research on coal mining subsidence sites in coal cities.

2. Influence analysis of coal mining subsidence areas in hegang city

2.1. Initiating geological disasters

The coal seams in Hegang City are concentrated, the mine has a long history of development, and the mining activities are frequent. Today, the pattern of “there is coal under the city, there is a city on the mine, and the city and mine are not divided”. With the large-scale coal production, coupled with the impact of changes in natural conditions, the Hegang coal mining area has produced a large area of coal mining subsidence, as shown in Figure 1. According to incomplete statistics, the direct losses caused by geological disasters such as land subsidence, ground fissures and ground subsidence caused by coal
mining subsidence every year are as high as more than 20 million yuan. Coal mining subsidence not only caused geological disasters to cause great losses to people's lives and property, but also caused frequent vegetation cover degradation, soil quality reduction, soil erosion and other phenomena, which caused great damage to the ecological environment[3].

![Figure 1. Space distribution of coal mining subsidence area in Hegang city](image1)

![Figure 2. Overlay layer of shanty town and coal mining subsidence](image2)

2.2. Impeding road traffic construction
In the urban master plan revision of 2012-2020, Hegang City carried out preliminary planning and design of the traffic lines. The subsidence area during the period of 2014-2020 and 2014-closing is predicted. The traffic routes initially planned in the general revision are superimposed with the predicted subsidence areas. It is estimated that during the period of 2014-2020, a total of 70.77km of traffic lines are in the area of coal mining subsidence; during the period of 2014-closing period, a total of 167.07km of traffic lines are in the area of coal mining subsidence, which seriously hindered the construction of road traffic in Hegang City. See Table 1 for details.

| Traffic line type        | 2014-2020 | 2014- closing |
|-------------------------|-----------|---------------|
| External traffic        | 12.75     | 37.66         |
| Secondary Trunk Road    | 13.63     | 30.23         |
| Midline                 | 44.39     | 99.18         |
| Total                   | 70.77     | 167.07        |

Table 1. Road length statistics of coal subsidence area influence (km)

2.3. Restricting the renovation of shanty towns
Due to the influence and changes of external environmental factors and human activities, the coal mining subsidence area may be moved and deformed at any time[4], which greatly limits the renovation of shanty towns. Immigration is an important means to solve the human development in coal mining subsidence areas[5], but it will bring certain economic losses. The survey shows that Hegang City has 26 shanty towns with a total area of 1226.14 hm². Through the transformation of the shanty towns, 16 new residential quarters will be built, covering an area of 454.04 hm², 13 new ones will be built, and 3 new ones will be built in different places. The superposition analysis shows that among the 26 shanty towns in Hegang City, 15 shanty towns are located within the existing subsidence area. From 2014 to 2020, the new residential area will not be affected by subsidence. From 2014 to closing, the new two residential area will be influenced by subsequent coal mining, as shown in Figure 2.

2.4. Harm existing industrial areas
Buildings within the coal mining area will be affected to varying degrees by coal mining subsidence, making it damaged and unable to function properly[6]. At present, there are four industrial parks be
built around the Hegang mining area, namely Xingshan Industrial Park, South Wing Industry undertakes gathering Area, Nanshan Re-employment Industry Cluster, and Coal Chemical Industrial Park. The future coal mining subsidence area be superimposed with the industrial park to analyze the impact of future coal mining on the industrial park. The results show that from 2014 to 2020, two industrial parks in Xingshan Industrial Park and Nanshan Re-employment Industry Cluster will be affected by coal mining subsidence, as shown in Figure 3; 2014-closed mine, Xingshan Industrial Park, Nanshan Re-employment Industry Cluster and Coal Chemical Park will be affected by coal mining subsidence, as shown in Figure 4.

3. Integrated governance planning strategy of coal mining subsidence areas in Hegang city

3.1. Innovative concept of Integrated governance planning for coal mining subsidence areas

Considering the three aspects of promoting Hegang economic development, ensuring farmers' income and improving ecological environment, three innovative concepts for integrated governance planning of coal mining subsidence are put forward, namely “economic engine, people's livelihood security, urban green lung”.

1) **Economic engine**: In 2015, Premier Li Keqiang presided over the work conference to revitalize the old industrial bases in the northeast region, and proposed to give full play to their own advantages while actively promoting the transformation of resource-based cities. Through the treatment of coal mining subsidence sites in Hegang City, the construction projects such as the stable and stable areas and the temporary stable areas will be fully utilized to provide construction land use indicators to promote the economic development of Hegang City.

2) **People's livelihood security**: Through the treatment and planning of coal mining subsidence, the maximum area of cultivated land available for restoration can be restored, and the transformation of shantytowns, old industrial areas and independent mining areas can be accelerated to meet the actual needs of people's production and life. Increase the income of farmers and ensure the peace of the people of Hegang City.

3) **Urban Green Lung**: The economic construction and ecological construction of the city should be coordinated and developed. For the subsided land that is difficult to reclaim as cultivated land or construction land, it will be reclaimed as an ecological green land to create a natural oxygen bar in Hegang City. To provide an ecological barrier for the economic development and people's happiness of Hegang City, to meet the needs of the people in the mining area to improve their quality of life, and to build a beautiful home of ecological mining areas, livable and suitable, and land-water-human harmonious symbiosis.
3.2. Planning strategy for the zoning integrated governance of coal mining subsidence areas

Combined with the actual characteristics of coal mining subsidence area in Hegang, and focusing on the industrial land demand and future development orientation of Hegang City related planning, the functional partition layout of “one corridor and four districts” was proposed. Among them, “one corridor” and “four districts” refer to “Eco-circulation industry corridor”, “sightseeing tourist area”, “ecological agricultural area”, “modern industrial area” and “landscape leisure area”, as shown in Figure 5.

(1) Eco-circulation industry corridor

The “Eco-circulation industry corridor” runs through the coal mining area of Hegang City, from Xingshan Coal Mine in the north to Junde Coal Mine in the south, and the length of the promenade is about 29km. Taking coal grain and food, urban development and ecological optimization as the governance objectives, relying on the development of mining industry, combined with the local cultural characteristics, through governance of the subsidence to create an ecological economic corridor integrating tourism, ecology, industry and leisure in the east of Hegang City. In order to promote the rapid development of Hegang City's economy.

(2) Sightseeing tourist area

The sightseeing area includes the eastern part of Xingshan Coal Mine and most of Yixin Coal Mine, with a planned area of 19 km². It is predicted that when the mine is closed, the maximum sinking value is about 39.40m. Relying on the characteristics of “mine” and the rich tourism resources around it, such as Hegang City National Mine Park with unique mine characteristics, Lingbei Open-air Coal Mining Waste Field Afforestation and Reclamation Base, and the Mine History Museum and Dongshan Mass Pit, which have a hundred years of history in Hegang City. Together with the Beishan Nature Park, which has natural scenery and original ecological beauty, it creates a unique tourism brand in Hegang.

(3) Ecological agricultural area

The ecological agriculture area is mainly composed of Zhenxing Coal Mine, Nanshan Coal Mine, Bird Mountain Coal Mine, Fuli Coal Mine and Xinlu Coal Mine. The total planned area is 37 km². It is predicted that when the mine is closed, the maximum sinking value is about 19m. On the one hand, according to local conditions, the development of vegetable greenhouses, plantations, picking gardens, etc., in accordance with the requirements of circular economy and low-carbon economy, develop characteristic ecological agriculture; on the other hand, as a supporting area of the northern sightseeing and tourism area, jointly promote the development of tourism in Hegang City.

(4) Modern industrial area

The modern industrial zone is located in the northeast of the Hegang coal mining area, including Xinlu West, Yixin West and Nanshan West, with a planned area of 13 km². The administrative area is mainly affiliated to the northeastern part of Xingshan District of Hegang City, the southeast of Xiangyang District, and the eastern part of Nanshan District. It is less than 5km away from Hegang Railway Station. Make full use of the region's already stable advantages, develop coal, grain, timber intensive industrialization groups, high-tech information industry, and explore modern industrial models with quick results and coordinated development.

(5) Landscape leisure area

The landscape recreation area includes Xing'an Coal Mine and Junde Coal Mine with a planned area of 41km². The area will be seriously sunk in the future, with a maximum sinking of 32.90m. It is not suitable for building buildings and can be planned as a recreation area. On the one hand, combined with the development plan of Hegang South New City, the landscape recreation area is built according to local conditions; on the other hand, considering the construction of the western Coal Chemical Industry Park in Hegang City, it is a leisure and entertainment place for urban residents and workers while improving the regional ecological environment.

3.3. Implementation measures for integrated control planning of coal mining subsidence areas

(1) The state supports local application governance
According to the “Notice of the Pilot Work on the Rehabilitation of Industrial and Mining Wasteland” by the Ministry of Land and Resources of the People's Republic of China in 2012 and the Pilot Work in Ten Provinces and Cities, the abandoned land of industrial and mining can be reclaimed as cultivated land and replace the corresponding construction land indicators. Each year, the state has 100 billion yuan of new construction land paid for use in land remediation (including land development, consolidation, reclamation), and is managed by the Ministry of Land and Resources and the provincial and municipal land and resources management departments. You can apply for the relevant land improvement project to the Ministry of Land and Resources of China, or apply for land improvement projects in the provinces and cities. The implementation of the “Land Reclamation Regulations” on March 5, 2011 stipulates that land damaged by history may be supported by relevant financial support from the state and the provincial government, or in accordance with the principle of “who invests and who benefits” to attract social investment for reclamation[7].

(2) The company fulfills its obligations and manages itself

The “Land Reclamation Regulations” stipulate that land damaged by production and construction activities shall be responsible for land reclamation by the production and construction unit or individual in accordance with the principle of “who is ruined and reclaimed”. Otherwise, when applying for a new mining license or applying for a mining license for continuation, alteration, or cancellation, the competent land and resources department that has the approval authority may not approve it[7]. Therefore, mining enterprises need to manage or pay for the cost of coal mining subsidence. According to the “Regulations on Mine Geology and Environmental Protection of Heilongjiang Province” (2009), the mine geological environment deposit required by mining enterprises is used to ensure the scientific management of the geological environment. This is a considerable amount of money that can promote the effective management of coal mining subsidence.

4. Conclusions

For a long time, the predatory coal mining did not take into account the recovery and utilization of the land in the coal mining area, resulting in a large number of coal mining subsidence areas that are difficult to use. Coal mining subsidence has caused serious damage to the land, water resources, buildings and ecological environment of the mining area, which directly affected the urban economic development, social stability and sustainable development of the ecological environment[8]. Therefore, it is imperative to carry out comprehensive treatment planning for coal mining subsidence area.

From the perspectives of economy, people's livelihood and ecological environment, combined with the actual characteristics of coal mining subsidence in Hegang mining area, related planning industry land demand and future development orientation, it has been proposed to integrated governance planning for coal mining subsidence area by developing tourism, ecological agriculture and modern industry. The government gives certain funds or policy support, and the company fulfills its governance obligations and cooperates with all parties to promote the rational implementation of the comprehensive management plan for coal mining subsidence area. At present, most of the mining areas have been treated after the mining destroys the land. Not only was it difficult to manage, the cost was high, and the impact was wide, which also seriously hinders the sustainable development of the city. Governance during or before land destruction[9] could minimize the impact of coal mining subsidence on the ecological environment, production and life, as well as the economic losses.

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