

# Influence of coal mining on the lower Yellow River region and related management countermeasures-- Taking Heze mining area as an example

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**Abstract:** To realize the ecological protection and high-quality development of the Yellow River basin is related to the centenary project of the Chinese nation. The middle and lower reaches of the Yellow River are rich in coal resources and have a long history of mining. Large-scale coal mining activities lead to the destruction of underground aquifer, surface subsidence and the reduction of cultivated land, which seriously threatens the safety of local ecological environment, land resources and water resources. Luxi coal base Heze mining area, for example, the analysis of coal mining activities and land resources, ecological environment, the contradiction between water resources protection and its causes, and put forward preventive measures, to help alleviate the lower Yellow River coal mining and land resources, ecological environment, water resources protection, to realize luxi mining area and the lower Yellow River ecological environment protection and high quality development is of great significance.

**Key words:** lower Yellow River area; coal mining activities; soil and water protection; ecological protection; high-quality development

## 1. Heze mining area overview

Heze mining area is rich in coal resources, is one of the national key planning and construction of 14 large coal production base — an important part of coal base, the main distribution of giant wild coalfield, cao county coalfield, shan county coal field, accumulated proved coal reserves of 10.058 billion tons, accounting for about 21% of the proved coal reserves in Shandong province. Mining area mainly mining 3 coal seam, coal seam in average buried depth between 600m and 1200m, the mining area is a total of 7 mine production, a pair of the mine under construction, mining area in 2021, coal resources output of 18.1 million tons, accounting for 19.5% of coal production in Shandong province, Heze mining area safety production for the whole luxi coal base energy supply has an important impact.

## 2. Surface moving deformation mechanism

After coal extraction, the original stress balance of the goaf rock layer destroyed, the goaf rock layer in the surrounding rock pressure and its gravity, falling, fracture, bending, through the rocks, eventually to the surface, forming a nearly oval much larger than the goaf area

sinking basin[1] .Affected by the fluctuation, destruction and bending of the overlying rock formation in the goaf, the hydrological environment and the surface of the underground rock formation covered by the goaf have also changed significantly. There are two main functions: (1) Under the perennial alluvial of the Yellow River in the lower reaches of the Yellow River, the geological conditions characterized by huge thick loose layer and high diving level have been formed. Under such geological conditions, after coal extraction, the surface is obviously deformed by [2]. Affected by the high diving level in the quaternary loose layer, after the surface subsidence reaches a certain value, the water flows out, forming a contiguous coal mining subsidence water area, which seriously affects the use function of the land.

(2) Before the coal is extracted, the whole geological environment is in a relatively stable state, and the relative change range of the groundwater level is small. After coal extraction, the water in the upper aquifer under gravity, will penetrate down through the microcrack, with the erosion effect of the water flow, the original microcrack in water pressure, gravity, and water erosion, further expand, expand the water, destroy the original stability of the aquifer. See the details shown in Figure 1.

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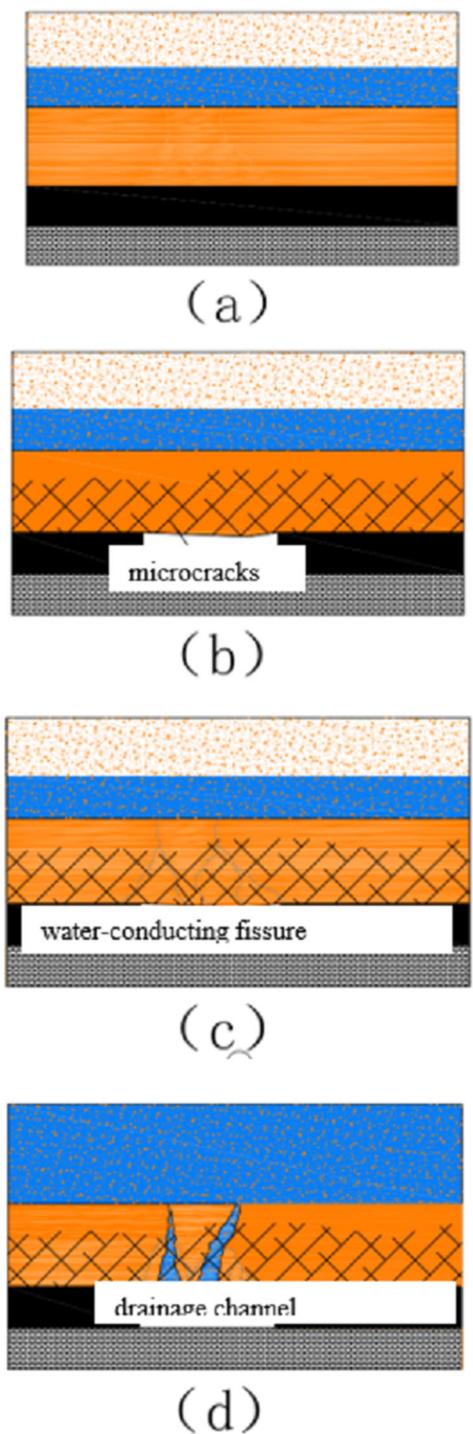


Figure 1 Schematic diagram of the conduction process of overcovering aquifer after coal seam mining

### 3. Problems caused by coal mining

#### 3.1 Damage to cultivated land

According to relevant statistics, there are existing coal mining subsidence areas of 4301.7511 hectares of Heze mining area, and the Heze mining area is drawn according to the survey data. See the details shown in Figure 2.

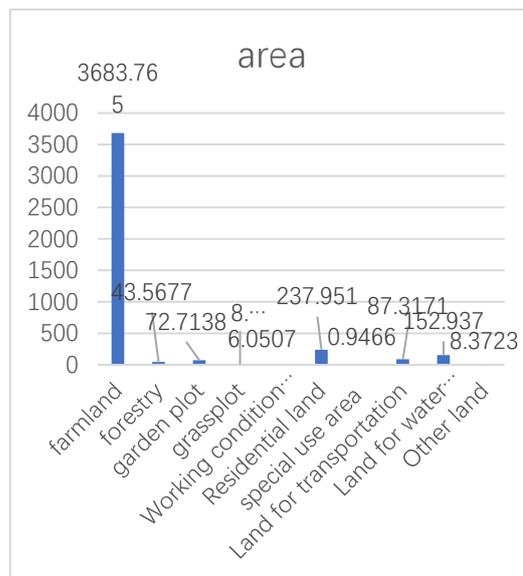


Figure 2 Map of various land damage in Heze mining area

According to FIG. 2, there are 10 land types of damaged cultivated land, residential land, water area and water conservancy facilities land, garden land, woodland, grassland, industrial and mining storage land, special land, transportation land, and other land. The maximum cultivated land area is 3683.7650 hectares, accounting for 85.63% of the total subsidence area; second, residential land area 237.9510 hectares, 5.53% of the subsidence area; water conservancy area 152.9370 hectares, 3.56% of the subsidence area, and 94.72% of the total subsidence area.

#### 3.2 Ecological destruction

After coal extraction, large seasonal water areas and perennial water areas will be formed, which will not only destroy the original agricultural ecological balance, and seriously damage the original relatively stable soil structure and geological environment, but also threaten the biodiversity.

According to relevant statistics, at the end of 2021, the coal mining subsidence area was 810.5372 hectares, accounting for 18.84% of the total subsidence area, 302.4563 hectares, 7.03% of the total subsidence area, and 3188.7576 hectares, accounting for 74.13%.

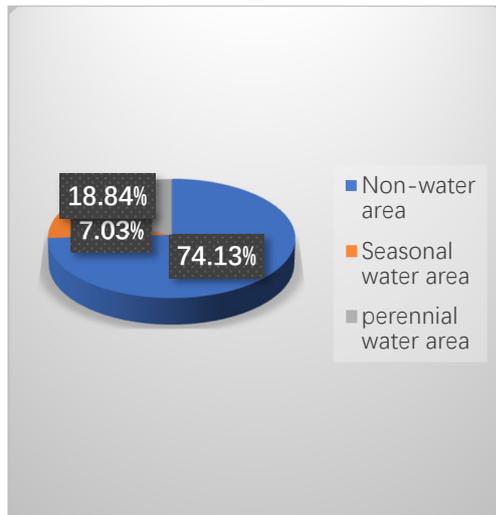


Figure 3 Distribution of coal mining subsidence land in Heze mining area

### 3.3 Waste of water resources

Heze mining area is mainly agricultural production, dense population, many towns, the demand for water resources is very huge. Large-scale coal mining activities have caused a series of water resources protection problems, and coal mining activities caused by water resources damage is mainly reflected in two aspects:

- (1) Coal mining activities have seriously damaged the underground aquifer, leading to the reduction of the water level of the groundwater aquifer, and aggravated the dependence of the lower Yellow River region on surface water.
- (2) Coal production activities will produce a large amount of waste water [3], dust and harmful gases, coal gangue, fly ash and other accumulated waste will be dissolved by rainwater will also pollute the channels, rivers and lakes. In addition, due to the decline of underground aquifer water level, agricultural irrigation and other production activities are very dependent on the irrigation of the Yellow River water resources [4-5], resulting in the utilization of water resources of the Yellow River is tight.

## 4. Prevention and governance measures

### 4.1 Land resource protection

"Very cherish and reasonable use of every inch of land, to protect cultivated land" is a basic state policy of our country, protect land resources must be based on the present, the "source control" and "process management" as the new concept of mining ecological environment management [2], based on accurate mining damage prediction, mining and ecological restoration, the organic combination of land reclamation. Drainage drainage, shallow excavation and filling method, and dynamic pre-reclamation method and active prevention method shall be adopted in the predicted areas.

### 4.2 Ecological and environmental protection

The ecological security of the Yellow River basin is not only related to the ecological security of the north, but also related to the ecological security of the whole country. Lucid waters and lush mountains are mountains of gold and silver, and a sound ecological environment is the most beneficial to people's livelihood. Coal mining activities destroy the ecological environment of the surface and lead to the deterioration of the lower reaches of the Yellow River.

### 4.3 Water resources protection

The advantages and wealth of water resources affect the social stability, economic development and people's happiness index of a region. While coal mining, it is necessary to avoid the pollution and damage of the underground aquifer, reduce blocking and cut water loss and pollution; adopt green coal mining process to reduce the possibility of cracks caused by surface deformation and prevent the surface water through the cracks of surface water leakage.

Water resources should be rationally distributed and utilized, rationally allocate water consumption for industrial, domestic and agricultural purposes, and ensure that the principle of "water, land, people and production by water" should be adhered to, and the overall distribution of water use in cities, towns and villages should be reasonably planned.

## 5. Conclusion and Outlook

The Yellow River is the mother river of China. Protecting the ecological environment of the Yellow River will benefit for generations to come. According to local conditions, reasonable remediation, adhere to the concept that clear water and green mountains are gold and silver mountains, broaden the concept of ecological governance; adhere to the source control, process governance, solve the problem of land resource damage in the development process; choose reasonable mining methods to reduce the impact of underground mining on the underground aquifer, reasonable distribution of water resources, to solve the problem of unreasonable distribution of water resources in the Yellow River basin. The coordinated development of coal mining activities and ecological protection, water resources protection and land resources protection plays a positive role in promoting the ecological protection and high-quality development in the lower Yellow River basin.

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