Research on Ecological Environment Protection of Mining Area Based on Yangquan No. 3 Mine

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Abstract. [Objective]: To solve the environmental problems of Yangquan No. 3 mine and improve the natural environment of the mine area and its surroundings by reasonable utilization and transformation. [Methods]: Data were processed and superposed through GIS analysis platform, and Yangquan No.3 mine was taken as a case for planning and design. [Results]: The basic conditions of Yangquan No. 3 mine were sorted out, and the land suitability evaluation results were obtained in the GIS analysis platform, and the site layout planning was carried out. To promote the mine landscape ecological restoration work, so as to realize the mine landscape ecological restoration work has made an important contribution. [Conclusion]: Based on the preliminary analysis of Yangquan No. 3 mine, combining with the cultural characteristics of the region to determine the planning and design objectives, and finally realize the overall layout planning of the abandoned mining area.

Keywords: ecological environment protection, mining landscape planning, land suitability evaluation, GIS.

Article 8 of the communist party of the eighteenth big report specifically, "vigorously promote the construction of ecological civilization, adhere to the basic state policy of resource conservation and environmental protection, insist on saving and protection of preference, and the principle of natural recovery, promoting green development, the development cycle, low carbon development, form the space pattern of resource conservation and environmental protection, industrial structure, mode of production and way of life, from the source to reverse the trend of ecological environment deterioration, production to create a good living environment for the people, make great contribution to the global ecological security. [1] "In recent years, due to environmental damage caused by mining, urban ecological environment and space development have been seriously affected, and environmental degradation has exerted a significant impact on the ecology. Therefore, people pay more and more attention to the landscape planning of mining areas. In January 2020, the Ministry of Ecology and Environment held the 2020 National Conference on Ecological and Environmental Protection in Beijing, and analyzed the current situation of ecological and environmental protection. Therefore, the construction of ecological and environmental protection in mining areas has become an urgent task in China. If relevant measures are not taken, it will hinder the progress of ecological civilization.
The ecological environment protection, the transformation of coal enterprises and the sustainable development of mining cities promote the landscape planning of mining areas. The landscape planning of mining area has been influenced by many aspects. In the exploitation of resources, the regional environment will be destroyed to a certain extent, which forces them to carry out ecological reconstruction of the mining area landscape. Meanwhile, the reuse of idle resources plays a positive role in the reconstruction of mining area. In addition, the construction of ecological civilization, such an opportunity also promoted the landscape planning of the mining area.

1. Project Analysis

Yangquan mining area is located in the western foothills of Taihang Mountain, which is high in the northwest and low in the southeast. The study area is located in the west of the mining area, 7.5 kilometers away from Yangquan city center. Coordinates: east longitude 113°21′-113°31′, north latitude 37°51′-37°56′. This region belongs to the continental climate of warm temperate zone. The average annual precipitation in this region is 590 mm. The spring and winter festivals are more northwest wind, the summer more southeast wind, the autumn more west wind.

![Figure 1. Land suitability evaluation map Image credit: Author's own drawing](image)

The study area has convenient and developed transportation. The main plant and equipment of the mining area are concentrated in the northeast, farmland and some vegetation restoration sites are reserved in the middle, and the original plant community is mainly in the southwest (As shown in Figure 1). According to network data and field visits, the elevation of the study area is about 750 to 1050 meters. The general terrain is high to the northwest and gradually decreases to the southeast. Most of the abandoned farmland in the study area is not suitable for planting because of the topography. The production areas and gangue and rock mountainous areas are covered by coal dust and gangue wastes from coal production. The main tree species in the study area are poplar, sophora, elm, etc.; the economic tree species are mainly apple, pear, apricot, jujube, walnut, peach, hawthorn, etc.; the shrub species are mountain grape, sour jujube, vinegar willow, thorn, etc.; the wild plant species are wild soybean, wild cotton, wild chicory, cauliflowers, etc. The land resources in the mining area are characterized by low per capita land index and shortage of land resources, and agricultural development and urban construction are greatly restricted. The surface of the soil is hard and firm, lacking moisture and organic matter. There are far fewer nutrients in the soil than in normal soil.

2. Land suitability evaluation based on GIS
In the GIS geographic space analysis platform, the raster data evaluated by all single factor factors are used to obtain the land suitability evaluation chart (As shown in FIG. 2). According to the evaluation value of each single factor, the grading range of the three land use categories is respectively 1-2.5, 2.5-4 and 4-5.5. The higher the score, the higher the land suitability (as shown in Table 1). In the GIS analysis platform, the four factors were assigned respectively, and the land suitability evaluation chart of Yangquan No. 3 mine was obtained by the superposition analysis of grid operation.

![Legend](image)

**Figure 2. Status analysis diagram Image credit: Author's own drawing**

**Tab. 1 Table of suitability classification criteria**

| Class level | Evaluation score | Suitability category |
|-------------|------------------|---------------------|
| I           | 4-5.5            | Most suitable       |
| II          | 2.5-4            | More suitable       |
| III         | 1-2.5            | Just suitable       |

3. **Planning Concept**

Mining area planning concept -- ecological landscape, green industry. It provides a kind of high quality, functional compound living space and working mode for the people in the mining area and the villagers in the surrounding villages.

People-oriented -- provide a high-quality function, loaded living space and working mode for the people in the mining area and the residents in the surrounding villages. Ecological landscape -- to maximize the preservation and utilization of the existing terrain. Create an interesting ecological landscape pattern. Sustainable development -- Building roads, plant layout planning is an important element to promote sustainable development. Landmark features - to create a regional symbolic significance of the industrial landscape core area.

4. **Planning and Design**

First of all, the current main road system, the SLOPE direction analysis map based on GIS and the land suitability assessment map are superimposed to obtain the superimposed analysis result map, and the overall layout planning is carried out according to the superimposed analysis result (As shown in Figure 3). The landscape design of Yangquan No. 3 Mine respects the natural spatial structure of the mining area and determines different functional zones according to the characteristics of the site. This design divides the site into three areas, namely, ecological restoration area, ecological agriculture area and landscape remolding area.
4.1. Overall layout

Ecological Restoration Area (A): Ecological original conservation area: Located in the northwest of the study area, the ecological landscape in the area has not been destroyed, the original ecological community is protected intact, the ecological environment is integrated, the animal and plant ecological chain in the area is relatively stable, and it is the natural oxygen bar of the whole mining area.

Artificial assisted restoration area: This area is located in the northwest of the study area. Through artificial restoration of green plants, the damaged surface morphology is ecologically restored to green. According to local conditions, make full use of the effect of plants on ecological restoration, carry out regional greening, fix the slope in the area, and form an ecological area with artificial auxiliary design.

Ecological agriculture Area (B): Ecological agriculture planting area: mainly considering the north in cold winter, the temperature difference between indoor and outdoor can reach 30 degrees. Therefore, the ecological model of "four in one" is adopted, and four factors such as solar energy, protected land cultivation, solar greenhouse and toilet are utilized. Under the combined condition of natural and artificial regulation, solar energy and biogas are formed through rational allocation, and biogas residue and biogas slurry are used as fertilizer source, so as to realize a virtuous circulation system of planting industry [2]. Ecological agriculture experience area: make use of farmland landscape to provide agricultural experience, so that tourists can participate in farming and feel the agricultural interest. At the same time, agricultural activities, farming culture and agricultural knowledge will be combined, while inheriting the farming civilization, through the original village, the original custom farming experience, to show the agricultural production and labor scene. Landscape reconstruction area (C): it includes industrial landscape tourism area, cultural and entertainment area, ecological corridor exhibition area, constructed wetland, riverside garden, reception and exhibition area, production and experience area, entertainment and rest area and leisure area. Industrial landscape tourist area: This area includes industrial souvenir shopping center, coal science virtual experience area, coal museum and handicraft experience center. The area is the use of existing industrial plant, equipment, through orderly integration and transformation. In the industrial landscape tourist area, visitors can enjoy the display of various industrial landscapes and technological processes. Cultural and entertainment area: this area is reconstructed from the existing buildings of the site. It is mainly used to carry out various folk cultural activities and display the local unique culture. Industrial corridor: Embodies the unique industrial culture of the mining area. Based on the above analysis and research, the overall layout of the mining area is...
finally obtained (See Figure 4). Through three major blocks, the mine area is divided into reasonable layout, forming a comprehensive park integrating protection, recreation, display and entertainment.

![Figure 4. General layout Image credit: Author’s own drawing](image)

4.2. Road traffic planning
The road system planning of Yangquan Sankuang mine inherits the original road system. The main road is basically transformed from the original road, and its coverage is the landscape area of the whole mining area. The road system in the mining area is divided into three levels: first level road, second level road and third level road according to the functional requirements of each division. The first-level road runs through the three divisions; The secondary road network is the link of each node, connecting the landscape nodes of each partition. The third-level roads are mainly forest paths for tourists’ demand for sightseeing, recreation and viewing activities (See Figure 5).
4.3. Plant landscape planning
Adhere to the principle of native plants, suitable for the land and trees, adhere to the combination of ornamental and economic, artistic and functional consistency, adhere to biodiversity, reflect ecological stability [3]. Plant landscape zoning planning: Plant landscape configuration is mainly divided into three parts according to its functions and the number of visitors flowing.

4.4. Ecological design

4.4.1. Ecological revetments in the water system revetments in the study area adopt natural forms (As shown in Figure 6). Appropriate stones are placed along the banks to reduce soil erosion and achieve ecological effects with natural landscape and stable ecological functions.

4.4.2. Constructed wetland landscape design: Abundant rain in summer can conserve underground water, become meadow in spring and autumn, and create depressed landscape in winter.

4.4.3. A rooftop garden: This node is the entrance building and adopts the roof garden design (as shown in Figure 7). Roof garden not only has good cooling and heat insulation effect, but also beautifies the environment, purifies the air, improves the local microclimate, enriches the pitch landscape of the city, compensates the green ground occupied by buildings, and greatly increases the green coverage rate [4]. Roof greening adopts simple design, instead of planting large area of trees, it only adopts the way of planting lawn, which can not only save cost but also meet the function of rainwater interception. Due to the fact that flat lawn can make rain water flow away quickly, wavy lawn not only provides different spatial experience in form, but also extends the time for rain water to permeate in function [5]. The ground is made of pervious material. Retaining a piece of land slightly below the pavement surface and planting trees and vegetation on the ground can effectively facilitate rainwater collection and delay the peak of surface runoff. Permeable pavement itself has good ecological benefits, and its unique flexible pavement structure provides convenience for the overhaul and maintenance of the ground [6]. After the roof rainwater purification into the pool through the pipeline, used as water landscape, water for the waterscape to provide water resources.
4.4.4. The node of Hanxi is a square for rest, which adopts the design of Hanxi (As shown in Figure 8). Imitating the dry riverbed in nature, with pebbles of different shapes as the fundamental key, various plants growing in wetlands are arranged around it, creating the artistic conception of "Although made by human, wan wan is like the sky" [7]. Arid creek in the dry season, showing the dry landscape artistic conception; In the rainy season, it can hold water, which is conducive to the collection of rainwater.

Figure 7. Roof garden plane and analysis Image credit: Author's own drawing

Figure 8. Hanxi plane and its analysis Image credit: Author's own drawing
4.4.5. Infiltration rainwater garden. This node is adjacent to the constructed wetland, and the infiltration rainwater garden is adopted. The node uses permeable surface and networked plant communities to regulate rainwater runoff and alleviate rain pollution from non-point sources. Local tree species are preferred and trees with strong resistance are selected. Shrubs are selected with strong resistance. Further purify the rainwater to provide a good habitat for wildlife.

This node is located in the entrance parking area. Traditional parking lot green space is generally higher than the road surface and surrounded by impermeable road surface. When rainstorm comes, rainwater cannot be discharged into the green space, resulting in water accumulation on the road surface [9] (As shown in Figure 9). The green space of the parking lot at this node is slightly lower than the pavement surface, which is conducive to the timely discharge of rainwater into the green space. Moreover, the ground is made of pervious material, which can effectively delay the peak of surface runoff.

![Figure 9. Parking lot rain garden analysis Image credit: Author's own drawing](image)

4.5. Waste reuse design
Waste residue: large waste residue is accumulated and then covered with guest soil to form micro-topography, on which various vegetation species are planted to form a new vegetation landscape; Will be small waste residue, can be used as landscape pavement. Concrete: the concrete after breaking can be used as the filling of the landscape stone cage. SLATE: Abandoned pieces of SLATE, can be used as paving materials on the ground. Wood: the application of wood is very wide, can be used as landscape seat, wooden landscape pavement, etc.

4.6. Pedestrian line design
The nodes of the pedestrian tour line are mainly composed of industrial culture, folk culture, handicrafts, ecological display and agricultural experience. Visitors can experience various cultural activities (See Figure 10). The coal science popularization experience area is mainly converted from the original industrial workshop equipment in the mining area. Industrial steel frames are used to form air corridors and enrich visitors' viewing of the overlooking landscape [10]. The roof garden is formed by the roof of the building, which combines beauty and function. It not only has the enjoyment of beauty, but also meets the demand of rainwater collection and discharge. The original damaged exterior is combined with plant planting to form an industrial landscape. At the same time, abandoned railway tracks are used to form a linear landscape to excavate the unique coal culture of the mining area, including the history
of factory building, people's stories, equipment popularization and so on. An industrial culture corridor is designed to let tourists feel the red culture of the mining area. The farming experience area grows local special crops such as corn and potato. The use of farmland landscape, to provide farming experience, so that visitors participate in farming, feel the agricultural interest. At the same time, agricultural activities, farming culture and agricultural knowledge will be combined, while inheriting the farming civilization, through the original village, the original custom farming experience, to show the agricultural production and labor scene. The original factory building of the mining area is transformed into a folk cultural activity center with a folk activity square. Various folk cultural activities can be held on holidays and festivals.

Figure 10. Pedestrian map Image credit: Author's own drawing

4.7. Design of identification system
Signs are for the public. The signboard with local characteristics is a combination of function and beauty, which can become a beautiful landscape in the park. For the design of the sign system of Yangquan No. 3 mine, environmental protection should be taken into consideration first. Therefore, in the selection of materials, industrial wastes from the mining area and construction wastes from the demolition should be utilized as the materials of the sign system in the way of on-site reuse on the premise that no harm is determined.

5. Research Conclusions
In this paper, the ecological environment protection, landscape planning and land suitability evaluation are summarized. The protection of ecological environment and landscape transformation in foreign countries are carried out earlier than in China, which has experienced the process from the single reclamation and afforestation of mining areas to the comprehensive treatment and transformation. In addition, land suitability evaluation combined with geographic information system analysis platform plays a more and more important role in mining area landscape planning and design. Through discussion with relevant scholars, the importance of each impact factor is understood, and the superposition analysis of GIS lays a foundation for future landscape planning. Combined with literature review and relevant
case studies, this paper explains the theoretical basis of ecological environment and mining landscape planning, discusses the planning and design methods that can be used for reference, and puts forward the ideas and principles of mining planning and design.

Based on the preliminary analysis of Yangquan No. 3 mine, four influencing factors including elevation, road, slope and slope direction were selected. Through expert scoring and AHP analytic hierarchy process, the land suitability evaluation chart is obtained through weighted superposition analysis in GIS geographic information analysis platform. Then the planning and design objectives are determined based on the cultural characteristics of the site, and the overall layout planning of the abandoned mining area is finally realized.

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