

# *Analysis and Ecological Restoration of the Non-coal Mine Open Dump in Shandong Province Based on GIS and RS Technology*

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**Abstract:** This paper introduces the problem of non-coal mine open pit waste dump in Shandong province, puts forward the plant ecological restoration mode as the solution, analyzes the waste dump through adopting GIS and RS technology, analyzes from the four aspects: the elevation, slope, slope direction and ecological sensitivity of the design area, and combines the field investigation to carry out structural reinforcement design on the abandoned waste dump, plant design. The different plant species and plant levels are used for ecological restoration, so as to achieve the ecological restoration goal of improving ecological benefits and environmental protection.

## **1. Basic Status of Non-coal Open Pit Dumping Area in Shandong Province**

(1) In the open pit mine, in order to dig the ore from the ore body conveniently, it is often necessary to excavate from side slope. During the excavation process, the excavated earthwork needs to be transported to the corresponding dumping area through transportation equipment. In the dumping area of the non-coal mine open pit in the coastal area of Shandong Province, there are mainly two ways of back-filling and stacking. The shape and scale of earthwork stacking in the dumping area are different depending on the size of the mine and the shape of the ore body. Its area ranges from several hundred square meters to hundreds of square meters. The soil area in the design area reaches more than 60,000 square meters. [1] The stacking form of waste dump mainly includes mountain-shaped pile, the wave pile, which results in the safety of the surrounding villagers.

(2) The uncovered soil on the uncovered earthwork surface in the dumping area can cause serious dust raising problem. Such particles float in the air and can be blown away by wind, which results in polluting the air of the whole area. The flying dust has poor stability, large influence range and great harm to the surrounding environment. Absorbing and immersing for a long time in an area with excessively high dust concentration in a dumping area of an open pit, which may lead to allergies, respiratory diseases and other health problems. It also causes air pollution, reduces air quality, and destroys vegetation and soil.

## 2. GIS and RS Technology Analysis of Non-coal Open-pit Mines in Coastal Shandong Province

### (1) Data Source

The images which are produced by HRV (high resolution visible light scanner) has the advantages of high ground resolution, accurate location and better resolution than TM and MSS images [2]. Therefore, this study selects SPOT5 (Fig. 1) satellite remote sensing image of non-coal mine dumping ground in a certain city as interpretation information source. In accordance with the precision requirement of land use survey of mine dump, through the analysis of the scale relation of mapping and the resolution of remote sensing image, it can not only keep the authenticity of patch information but also improve the interpretation precision through using the 2.5 m resolution image. In the study, the data of the dump site map, the administrative division map, the nature and the green space survey of a mine are combined to conduct the survey. [3]



Figure 1: Design Satellite Remote Sensing Image

### (2) Geometric Correction

The computer processing of the remote sensing images is an important link in the application of remote sensing technology, and is also the premise of employing the remote sensing image for the field investigation [4]. In actual operation, the image processing software ERDAS8.7 is employed to correct the remote sensing image. Through the technical means of satellite remote sensing, the acquired satellite image is subjected to data processing, the remote sensing image map is digitally corrected, and a Mercator projection coordinate system is created in order to form a digital orthographic remote sensing image map (Fig. 2).

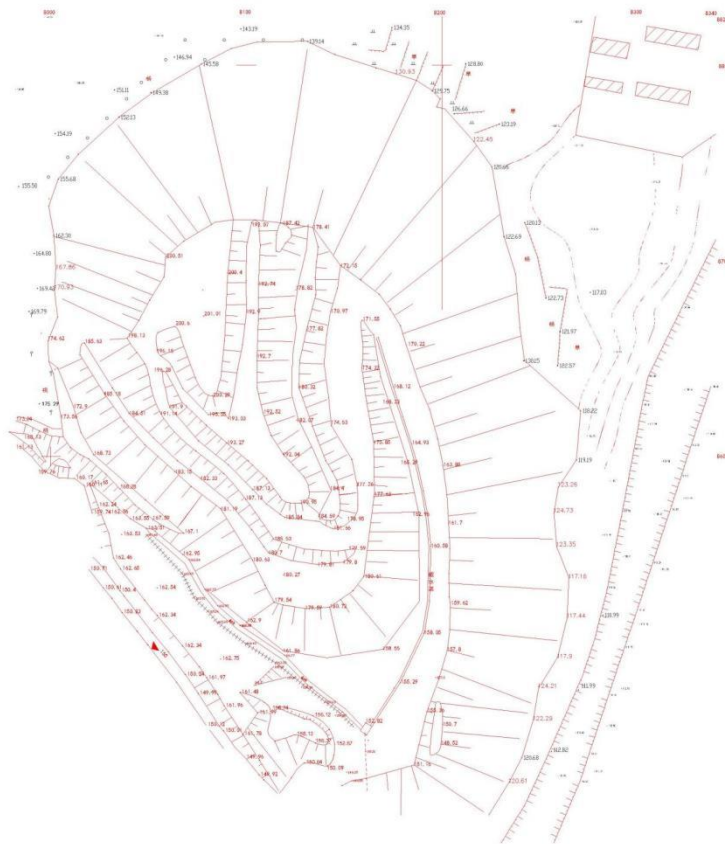


Figure 2: Digital Orthographic Remote Sensing Image

### (3) Field Data Investigation

As for the current characteristics of large land use area, the actual construction of the area should be surveyed in the early stage of the design in order to ensure the image interpretation quality and strive to have a full understanding of the planning area and objects [5]. Extract the information of the current urban land use property in the planning range, establish visual and interpretation digital signs in accordance with the different characteristics reflected through various terrain types collected in the planning range, and directly identify the terrain types on the images through using some acquired marks, perform inference analysis through the identified terrain categories or terrain phenomena, and finally further identify the terrain target that cannot be directly interpreted on the remote sensing image (as shown in Fig. 3).



Figure 3: Field Data Survey Chart

#### (4) GIS and RS Analysis Data

GIS can not only obtain the spatial information clearly, but also show the environmental quality and the environmental condition more intuitively and vividly [6]. With some unique functions of geographical spatial analysis and mixed data structure, various effective theoretical evaluation and decision schemes can be obtained, and important technical support and scientific basis can be provided for the environmental protection. The project analyzes the elevation by means of GIS (Fig. 4), the analysis shows that the highest height of the area reaches 36.8 meters; the lowest point is 1.3 meters, which covers an area of 63,600 square meters. GIS analyzes the slope (Fig. 5), and the area with a slope gradient of 10% accounts for the majority of the area. In this area, trees can be planted and drainage ditches and retaining walls can be built directly. If the slope gradient is less than 50%, ecological restoration can be carried out by leveling the terrain, building steps and tree pits, etc. and planting shrubs and herbs with a slope gradient of more than 50%. Break direction analysis (Fig. 6) meet the light demand of plants through GIS analysis, and also can carry out ecological restoration. Through GIS analysis of the ecological sensitive area of the area (Fig. 7), the non-sensitive area, low sensitive area and medium sensitive area in the area account for 70% of the total area. Plant ecological restoration Water system ecological restoration and other techniques are applied to repair and improve the ecology of the area, thus reaching ecological balance. As for the highly sensitive area and the most sensitive area, ecological restorations are achieved through plant cultivation.

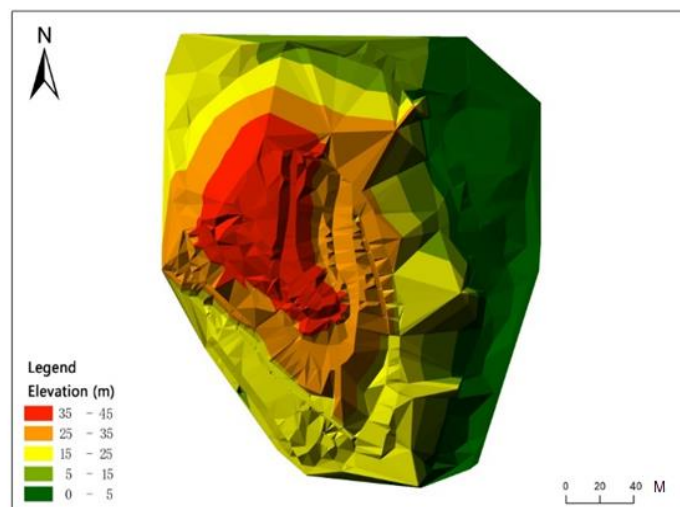


Figure 4: Design Area Elevation Analysis

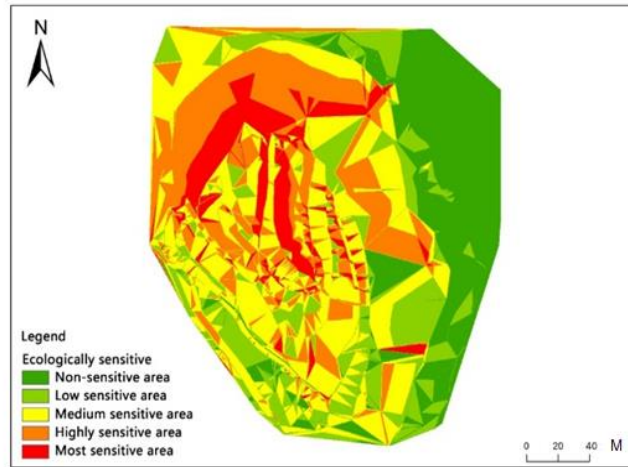


Figure 5: Design Area Slope Analysis

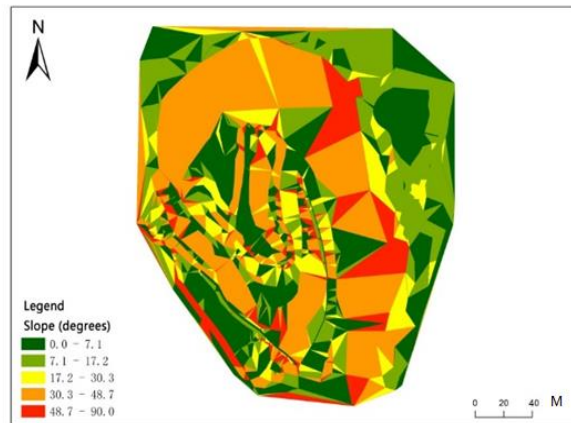


Figure 6: Design Area Slope Direction Analysis

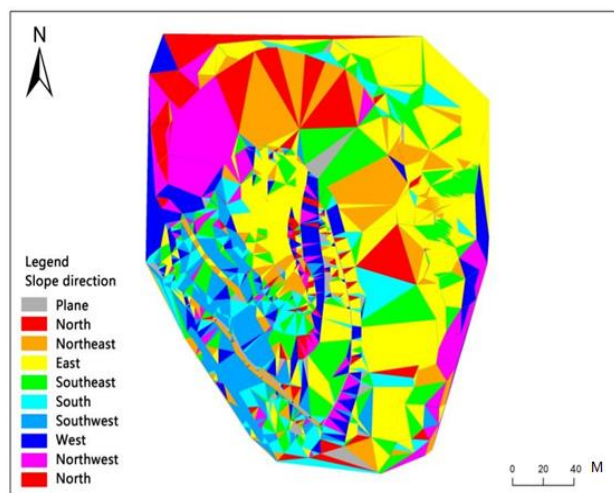


Figure 7: Design Area Ecological Sensitivity Analysis

### 3. Technical Measures for the Ecological Restoration of Non-coal Mine Open Dump in Shandong Province

In the plant ecological restoration mode of the dumping area of the non-coal mine open pit, the plant species which are suitable for the local environment need to be selected to achieve good ecological benefit and environmental protection effect. For the ecological fault problem of the mining area and the human activity area, the upper, middle and lower multi-layer plant restoration mode is mainly adopted [7]. The plant ecological restoration model mainly includes plant succession model, land balance restoration mode and green space construction mode. Plant ecological restoration model mainly includes plant succession model, land balance restoration model and green space construction model; land balance restoration mode is a recovery mode which controls the surface erosion and conveys nutrients materials inside and outside the soil; green space construction mode is a kind of governance mode which adds ecological system elements to the existing buildings and other hard surfaces, so as to strengthen the soil water retention and the then lower the temperature of the landscape. A number of factors need to be taken into account in the implementation of the ecological restoration plan, including the specific feasibility of the ecological planting scheme, the conservation of biological diversity and the improvement of soil quality, so as to ensure the long-term benefits of ecological restoration.[8]

(1) Selection and function of upper-layer restoration plants: The upper-layer plants mainly grow in the soil layer in the top of the mining area. They can quickly grow and form landscapes such as forest belts, which play an important role in the maintenance of mine soil and the supply of water and nutrients [9]. The plants can be arbor plants such as *Platycladus orientalis*, *Pinus bungeana*, *Robinia pseudoacacia*, *Sophora japonica* and the like, which have better ecological performance and are used for blocking wind sand, so as to reduce wind speed and then reduce the generation and influence range of dust.

(2) Selection and function of middle-layer plants: The middle-layer plants mainly grow in the middle-layer soil, and they are mainly some shrubs, which can fix the soil, promote the combination and decomposition of soil components, and prevent harmful phenomena such as cementation. Proper shrub planting can effectively avoid wind erosion and improve soil water and fertilizer retention. It is suggested that poplar, sand willow, cotton locust and other plants should form a natural barrier to absorb and block dust-raising materials, in order to reduce wind and dust.

(3) Selection and function of lower-layer restoration plants: The lower-layer plants grow in the lower soil layer of the mining area and the green belt around the mine site, which mainly include undergrowth herbaceous plants and ground cover flowers. The green plants such as golden-leaf miscanthus and *Parthenocissus quinquefolia* can effectively increase the soil cohesion, stabilize the soil layer, and form a plant structure with multi-level ecological function as a supporting plant for middle-layer plants. It is also possible to cover bare soil by planting herbs and using plant waste for soil covering, which can effectively reduce dust.

### 4. Conclusion

The environmental improvement and function promotion of tailing disposal area is a major task. It needs comprehensive planning and orderly promotion. It involves many aspects, but its potential and value cannot be ignored. On the basis of selecting representative ecological factors and aiming at tailing disposal area, an ecological sensitivity evaluation index system is constructed. Single factor analysis is carried out based on GIS technology. Ecological sensitivity is average, with mild sensitivity and insensitivity being the main parts. The research results provide the basis for the protection of ecological environment and the development and utilization of the land, and also provide references for the protection and rational utilization of the tailing dump.

With the national attention to ecological environment protection, the ecological sensitivity analysis and evaluation as the basic core content will be paid more and more attention. However, for the natural environment in different areas, the ecological environment problems are also different. Therefore, the evaluation results are subjectively and emphatically influenced by the data acquisition level and ecological factor selection. Thus, it is necessary to establish a scientific and reasonable ecological sensitivity evaluation method system in line with the specific watersheds and formulate protection planning measures for different sensitive areas according to the particularity of the ecological environment problems of waste dump, so as to better solve the ecological environment problems which are faced by the current research area.

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