



## **Analysis on the Balance of Soil Resources in Land Reclamation**

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**Abstract:** Land resource balance analysis in land reclamation is an important link in the preparation of land reclamation plans. This article summarizes the basic content and calculation methods of land resource balance analysis in land reclamation projects, and uses Yanchuan Communications Investment Group Co., Ltd. of Shaanxi Province. The analysis of the balance of soil resources in the land reclamation plan of the stone salt mine in the Zhongzhushan area of the county is illustrated as an example. Scientific and reasonable land resource balance analysis is the basis for the rational allocation of land reclamation land resources, which is conducive to ecological restoration after reclamation, alleviating human-land contradictions, and is also a necessary prerequisite for the implementation of land reclamation projects.

**Keywords:** Land reclamation; water and soil resource balance analysis; land resource balance; case.

### **1. Introduction**

Land reclamation refers to the activities of taking remedial measures to the land damaged by production and construction activities and natural disasters to make it available for use [1]. Land reclamation is an effective way to solve the contradiction between economic and social development, mineral resource development and land

resource protection, prevent environmental pollution, restore ecological balance, and promote social harmony. The balance analysis of water and soil resources in land reclamation should not only analyze the status quo and utilization potential of water and soil resources in the reclamation area, but also fully consider the changes in demand for water and soil resources brought about by changes in the land use structure after reclamation, and rationally allocate and utilize the reclamation area. Water and soil resources, improve the quality of reclaimed land, and then increase the output rate of reclaimed land, achieve the goal of alleviating the contradiction between human and land and achieving sustainable development. In land reclamation projects, land resource balance analysis is an important part of the feasibility analysis of land reclamation, which is related to whether the land reclamation can achieve the expected results. It is one of the important contents in the process of preparing the land reclamation plan[2] , The soil source balance analysis mainly refers to the analysis of the supply and demand of the topsoil used for reclamation, which is of great significance for the survival of the reconstructed vegetation and the productivity of the farmland vegetation. Many experts and scholars have analyzed soil and water resources in different regions. Duan Cailian [3] (2004) conducted a comprehensive study on the current situation of the development and utilization of water and soil resources in Ejina Oasis, used SD model to study the balance of water and soil resources in Ejina Oasis, and used the model to calculate the upstream discharge water volume and the land development scale of Ejina Oasis in the next 30 years , And calculated the water consumption of farmland irrigation, forest and grass irrigation, and ecological water consumption; Yang Yanzhao et al. [4] (2008) started from the relationship of resource balance and quantitatively analyzed the water and soil resource balance of Inner Mongolia under natural conditions, revealing the natural precipitation in Inner Mongolia. The balance relationship with crop water demand; Xu Qin et al. [5] (2012) summarized the characteristics of water and soil resource balance analysis in land reclamation, and put forward the main content of water and soil resource balance analysis in land reclamation. The water and soil resource balance analysis of the Jiangbei Well Land Reclamation Project of Jiangshang Coal Mine is taken as an example to illustrate. In the land reclamation project, the focus of the water and soil resource balance analysis is not only the water balance analysis, but the land resource balance analysis should also be paid attention to; Research involves land reclamation, which is a small-scale water and soil resource balance analysis, and focuses on the analysis of water supply and demand balance. In land reclamation projects, land resource analysis is equally important.

The object of soil resource balance analysis is topsoil. Topsoil refers to the topsoil or rock weathering that can be stripped and is conducive to rapid restoration of soil

fertility and plant growth. It is an important basis for the net primary productivity of the land [6]. The soil source balance analysis includes the calculation of the amount of topsoil stripping, the calculation of the amount of topsoil cover, and the calculation of the balance of supply and demand of topsoil.

## **2. Land resource balance analysis**

On the basis of determining the analysis unit, the soil resource balance analysis comprehensively considers the surplus and deficiencies of the soil resources in the analysis area, scientifically calculates the amount of topsoil resources that can be stripped and the amount of cover, and through the comparison of supply and demand, reasonable coordination of soil resources. The relationship between supply and demand is balanced to achieve the balance and rational use of land resources.

### **2.1 Determination of analysis unit**

Before analyzing the balance of soil resources, the analysis unit must be determined first. In land reclamation, the topsoil will be stripped before the temporary land is occupied, and then a storage yard will be set up for stacking. After the project construction is completed, the topsoil will be backfilled. The process involves a large amount of engineering, and the rejection of topsoil and the transportation distance of topsoil have a huge impact on the cost of reclamation. When reclaiming, the topsoil dumping site generally adopts the principle of proximity to facilitate the backfilling of the topsoil. Generally, a single temporary land parcel or a permanent land parcel is used as the analysis unit of the topsoil balance analysis.

### **2.2 Soil source stratification**

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Among the various soil layers, only the topsoil layer and the core soil layer meet the soil quality requirements of land reclamation. In the actual stripping process, in order to speed up the restoration of vegetation in the reclaimed area, the model of "layer stripping, layer stacking, and layer backfilling" can be adopted. The thickness of the topsoil that can be stripped is different for different land use types, and the stripping potential should be calculated based on the field survey.



a Cultivated land                      b Grassland                      c Shrubland  
 Fig. 1 Soil profiles of different land use types

### 2.3 Stripping calculation

Suppose the amount of stripped topsoil in the reclamation area is  $V$  ( $m^3$ ), and there are  $n$  ( $n \geq 1$ ) types of land use in the analysis area, of which the stripped topsoil area of the  $j$ th ( $j \leq n$ ) land use type is  $S_j$  ( $m^2$ ), The thickness of the stripped topsoil of the land use type is  $H_j$ ( $m$ ), and the calculation method of the topsoil stripping potential is as follows:

$$V = \sum_{j=1}^n S_j \times H_j \quad (1)$$

### 2.4 Calculation of soil cover

The amount of cover soil refers to the amount of topsoil required for reclamation, which is determined by the thickness of the cover soil and the area of the land after reclamation, and the thickness of the cover soil is related to the type of land use after the reclamation. Surface soil cover is the basis of vegetation reconstruction, and its quality is the key to the success or failure of reclamation and the level of benefit. Suppose there are a total of  $n$  reclamation directions in the reclamation area. The reclamation area of each reclamation direction is  $A_1, A_2, A_3, \dots, A_n$ , and the cover soil thickness of different reclamation directions are  $H_1, H_2, \dots, H_n$ , Then the soil cover  $M$  in the reclamation area is:

$$M = \sum_{j=1}^n A_j \times H_j \quad (2)$$

In the process of land reclamation, the effective soil thickness needs to be controlled. The effective soil layer thickness has regional differences, that is, different regions and different land use types have different control standards for the effective soil layer thickness. According to the "Land Reclamation Quality Control Standards" (TD/T 1036-2013), my country is divided into ten types of land reclamation areas, namely: Northeast Hilly Plain Area, Huanghuaihai Plain Area, Middle and Lower Yangtze River Plain Area, The southeast coastal mountain and hilly area, the loess plateau area, the

northern grassland area, the southwest mountain and hilly area, the central mountain and hilly area, the northwest arid area, and the Qinghai-Tibet Plateau area, and the scope of each land reclamation type area has been clearly defined.

### 2.5 Topsoil supply and demand balance analysis

After calculating the surface soil supply and demand balance calculation, the available surface soil amount and the cover soil amount in the reclamation area are calculated separately, and the remaining and shortfall of the surface soil amount are obtained by comparing them: 1) Oversupply. The amount of soil required is less than the peelable potential. In this case, the planning plan for subsoil stripping should be stripped based on the actual amount of soil required, and the stripping thickness can be reduced according to actual needs, thereby reducing the amount of work and the cost of reclamation; 2) The supply exceeds demand. In this case, foreign soil is required, and the foreign soil can be stripped from the permanent land occupation or purchased. If it is necessary to purchase the soil source, the quantity, source, location, and recoverable amount of the purchased soil shall be stated, and relevant certificates shall be provided. material. When using the guest soil, attention should be paid to the soil quality of the guest soil to prevent the introduction of contaminated soil into the reclamation area, causing secondary pollution; 3) Balance of supply and demand. The amount of topsoil stripping is equal to the amount of topsoil covering, and no additional soil is required.

## 3. Case analysis

### 3.1 Basic situation of the mine

Zhongzhushan Rock Salt Mine is a newly-built mine. The administrative division of the mining area belongs to Jiajiaping Town, Yanchuan County, Yan'an City, Shaanxi Province. It is located about 14km south of Jiajiaping Town, Yanchuan County. It is a typical Liangmao gully area on the Loess Plateau in northern Shaanxi. The geographical coordinates are east longitude: 109° 58'01" -110° 01'25", north latitude: 36° 57'17" -36° 58'55". The mining area is 12.2624 square kilometers and the planned production capacity is 10 million tons per year. The mine ground construction project covers a total area of 168,450 m<sup>2</sup>, of which the permanent construction land area is 53,600 m<sup>2</sup>, and the temporary land area is 114850 m<sup>2</sup> (including 61907 m<sup>2</sup> temporary land during construction period and 1,452944 m<sup>2</sup> temporary land during production period. Mine land composition: proposed mine surface construction project Including the brine mining workshop, the outer pipe gallery of the brine mining process, the brine (fresh) water external (return) pipeline, hydropower pipelines, well sites, connecting roads, and topsoil dumping sites. The assessment area has a single soil type, which is loess soil, and the soil texture is Silt or sandy silt, the soil parent material

is loess. The soil is loose and soft, the soil is light in color, the profile development is not obvious, and the soil erosion is serious. The soil fertility level is low. The current land use types in the mining area are divided into 6 first-class categories And 10 secondary categories, including: cultivated land, garden land, woodland, grassland, water area and water conservancy facility land, towns and villages, and industrial and mining land.

### 3.2 Land resource balance analysis

The soil resource balance analyzed in this plan is mainly for topsoil resources, which is of great significance for the reconstruction of vegetation survival and the productivity of farmland vegetation. It mainly includes soil supply analysis and soil demand analysis (Table 1). The exterior pipe gallery of the brine mining process only temporarily occupy the ground surface during the construction and demolition stage; the topsoil dump site can be plowed after the soil borrowing is completed, and the physical and chemical properties of the soil can be restored through land plowing and land fertilization in the later stage. The topsoil stripping does not involve the guest soil engineering. The topsoil of the brine (fresh) water (return) pipeline and the connecting road (greening) will be piled up independently during construction, and the topsoil will be leveled after the construction is completed, and the supply and demand of the topsoil of the single project will reach a balance. The topsoil stripped from the well site and connecting road (subgrade) during the construction period is transported to the topsoil dump site for storage, and used for land reclamation during the closed period. The part of the topsoil stripped by the brine workshop is used for on-site greening, and the remaining part is transported to the topsoil dump site for storage. The land reclamation surface soil demand of this project is 14602.51m<sup>3</sup>, and the surface soil stripping volume is 14602.51m<sup>3</sup>. The earthwork allocation in the project area can achieve a balance between supply and demand.

## 4. Conclusion and outlook

By expounding the basic principles and methods of land reclamation water and soil resource balance analysis, this paper separately studies the three important steps in soil resource balance analysis, including the basic calculation process of topsoil stripping calculation, cover soil calculation and topsoil balance analysis. On this basis, taking the Zhongzhushan rock salt mine as a case, the balance of soil resources in the mine's reclamation was analyzed in detail. Based on the analysis of the balance of supply and demand of topsoil, it was concluded that the amount of stripped topsoil could meet the amount of topsoil required for reclamation. , Can reach the quality control standard of land reclamation. The focus of water and soil resource balance analysis in land reclamation is not only water resource balance analysis, but land

resource balance analysis is as important as water resource balance analysis. A reasonable analysis of the balance between supply and demand of land resources is helpful to the scientificity of the preparation of land reclamation plans, ensuring the reasonable allocation of regional land resources and the restoration and reconstruction of vegetation ecology. The analysis of land resource balance is conducive to the coordination and unity of economic, social and ecological benefits of land reclamation projects.

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