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Ecological Security Guarantee Technology in Earth-rocky Mountainous Areas of Loess Plateau

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Abstract

The environmental conditions of earth and rock mountainous areas are severe, frequent natural disasters, shortage of cultivated land resources, and lack of comprehensive remediation technology and engineering measures, which severely restrict the improvement of local ecological environment and the high-quality development of agricultural production. This study summarized and analyzed the research status and the existing problems of the land remediation in the earth rock mountainous area of Shaanxi Province, clarified the terraced field construction technology and the slope ecological protection technology after the slope modification project in the earth-rocky mountainous area of the Loess Plateau, and constructed a spatial three-dimensional ecological buffer zone combining arbor-shrub-grass. The research results will provide theoretical and technical support for the increase of cultivated land, the improvement of regional ecological environment and the sustainable development of agricultural health in the earth-rock mountain area.

Keywords

Earth and Rock Mountainous Areas; Terrace Structure; Slope Protection.

1. Introduction

The ecological environment of the earth-rocky mountainous area is extremely fragile, with serious natural disasters such as soil erosion and landslides, barren soil, and low land utilization, facing the dual threats of a fragile ecological environment and shortage of cultivated land resources[1-2]. The mountainous area of Shaanxi Province is 7.41 million hm2, and there are a large number of soil and rock mountainous areas. Coupled with the interference of unreasonable reclamation, planting, mining and other activities, the amount of arable land has decreased sharply, and the regional contradiction between human and land has continued to intensify, which seriously restricts the improvement of the local ecological environment. As an important cultivated land resource for increasing farmers' income in the earth rock mountain area, slope cultivated land is widely distributed in this area, which contains rich cultivated land reserve resources and the potential of grain production. However, the soil layer of slope cultivated land in the earth rock mountain area is shallow, and there are ecological and environmental problems of running water, fertilizer and soil, resulting in the abandonment of more slope cultivated land[3-4]. Slope to terrace is an effective way to prevent soil and water loss, increase the area of cultivated land and protect the ecological environment. The

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transformation of slope cultivated land into terrace can slow down the slope of field, reduce surface runoff and enhance the soil's water and fertilizer conservation[5]. Therefore, it is necessary and urgent to carry out comprehensive land improvement in this area, improve the ecological environment, and increase the resources of arable land.

2. Structural Design of Terraced Fields and Ridges in Earth and Rock Mountainous Areas of the Loess Plateau

In view of the problems of shallow soil layer, poor structural stability, serious slope water and soil loss and lack of cultivated land resources in the earth rock mountain area of the Loess Plateau, based on soil erosion resistance and hydraulic stability, and aiming at the earth rock mountain area of the Loess Plateau with less annual precipitation and mainly composed of loamy soil, it is clear that the terrace design is mainly the reverse slope terrace with water storage and moisture conservation (the reverse slope angle is generally ≤ 2 °). After the implementation of the project, the soil water storage capacity of terraced fields increased by 4% to 17% compared with the surrounding sloping farmland. For areas with a height of more than 1.5 m, the double-slope structure and the ecological three-dimensional buffer zone of the side slope are designed with a "gentle-steep combination". The design parameters of the double-slope ratio field ridge were clarified, and a gentle slope ridge with a slope of about 45°, a bottom width of 80-100 cm, and a height of about 50 cm was constructed on the outside of each terrace. Combined with the vertical bearing characteristics of loess, a vertical steep slope ridge with a height of 1-1.5 m is set up in the lower part of the loess (Figure 1).

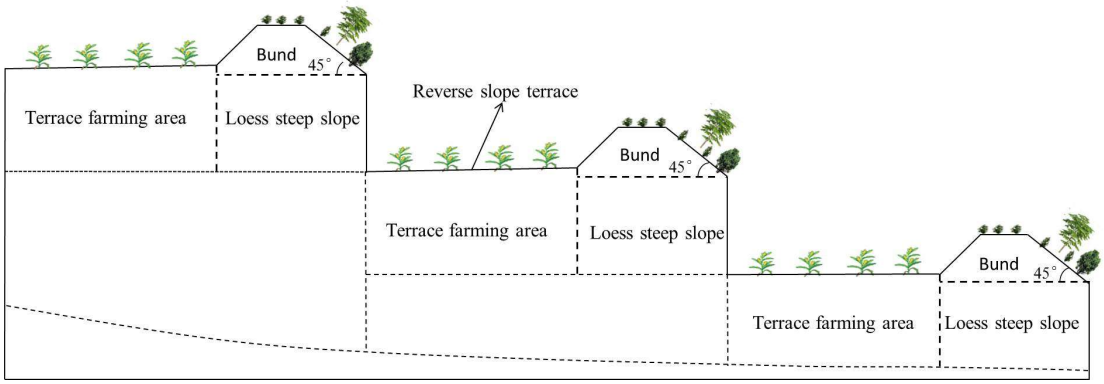

Figure 1. An environmentally friendly and structurally stable terrace structure design

3. Environmentally Friendly Three-dimensional Ecological Buffer Belt

A spatial three-dimensional ecological buffer zone combining arbor (gentle slope), irrigation (gentle slope) and grass (ridge top) is constructed (Figure 1). Economic trees and shrubs are planted on the gentle slope outside the ridge, and grasses are planted on the top of the ridge, which increases biodiversity. Through the odor emitted by the coupling of tree-shrub-grass plants and the attracted natural enemies, it can effectively prevent diseases and insect pests of crops in terraced farming areas and improve the regional ecological environment(Figure 1). Through the reinforcement and anchoring of different plant roots, the structural stability of the ridge is increased. The study found that the trees suitable for ridge stability and biodiversity in the earth rock mountain area of the Loess Plateau are Pinus tabulaeformis, Platycladus orientalis and Sophora japonica, the shrubs suitable for planting are Amorpha fruticosa, seabuckthorn and Caragana korshinskii, and the herbs suitable for planting are alfalfa, Astragalus adsurgens, sweet clover, corolla. In summary, the research results have improved the regional ecological environment(Figure 2).

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Figure 2. The renderings of the comprehensive improvement technology in the soil-rocky mountainous area before and after the implementation

4. Conclusion

The implementation of the technical achievements, firstly, increased the area of arable land in the earth and rocky mountainous areas, improved the utilization rate of land resources, improved the agricultural production conditions, and solved the problems of shortage of arable land resources and difficulty in developing reserve resources in the earth and rocky mountainous areas. The second was to transform the sloping land with a fragile original ecological environment into terraced fields with stable structure by constructing a three-dimensional ecological buffer zone, which increased biodiversity, effectively weakened crop diseases and insect pests, improved the regional ecological environment, and contributed to the economic development, which played an important role in promoting the economic development and ecological construction of earth and rocky mountainous areas.

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