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Application of soil reconstruction in terrace construction

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Abstract

Terracing project is an important measure for the management of slope cultivated land in China. As far as Longsheng County of Guangxi is concerned, the implementation of terracing project is conducive to the realization of agricultural growth, the development of rural economy, the prevention of soil and water loss, the improvement of farmland facilities, the reduction of field fragmentation, the improvement of cultivated land utilization level, the improvement of regional planting, production and ecological environment, and the formation of local microclimate. It plays ecological service functions such as water conservation, soil conservation, air purification, biodiversity protection, landscape recreation and so on. The development of terrace project has obtained huge economic, social and ecological benefits, and has important theoretical and practical significance for the intensive use of slope farmland.

Keywords

Terrace construction; soil reconstruction; physical reconstruction; biological nutrition reconstruction; chemical reconstruction.

1. Introduction

Guangxi Longsheng terrace project belongs to the design project. Longsheng Terrace is located in Longsheng Mountain, Pingan Village, Heping Township, Guizhi County, Longsheng Guangxi, 22 km away from the county seat and 80km away from Guilin City. It is called Longsheng Terrace in a broad sense and Longji Terrace in a narrow sense. Longsheng terrace renovation project is the first terrace renovation project in China, with a total investment of 25.4 million yuan [1,2]. The project area is 565.15 hm^2, and the cultivated land is 327.79 hm^2, all of which are terraced fields. After completion, the newly added farmland is 17.26 hm^2. From the foot of the mountain to the top of the mountain, there are 15,862 terraces of different sizes, the largest terrace is only 0.62 mu, and the small one is only inserted two or three rows of grass seedlings, forming a curve project of "hills like snails", "mountains into towers", "layers of terraces around the mountain village, and all channels pour mountain springs"[3, 4].

On May 18, 2006, the country's first terrace renovation project began here, marking a historic page in the protection and promotion of the natural and cultural heritage of Longsheng Terrace with a history of more than 650 years [5]. Since July 2006, the land and resources departments of Guangxi Zhuang Autonomous Region, Guilin City and Longsheng Autonomous County of all nationalities have begun to carry out research demonstration and project application for land renovation of terrace scenic spots, and included Longsheng terrace renovation in Guangxi's major village land renovation demonstration project.

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2. Application of soil reconstruction in engineering design

2.1. Soil physical reconstruction design

In the process of developing the terraces, the relevant departments did not give enough protection to the terraces, resulting in serious damage to many terraces, leaving the terraces deserted and the fields collapsing seriously. According to the field survey and investigation, there were 409 collapses of more than 20 m^2 in Long sheng Terrace scenic spot, with a collapse area of 17.48 hm^2. The abandoned terraces cover an area of 11.13 hm^2. At the beginning of the development of scenic spots, most scenic spots were established for the purpose of economic development. In the process of scenic spot development, economic goals occupy the main position, while local governments have low enthusiasm for resource protection and weak awareness of protection. Especially in the case of the outstanding economic value of the scenic spot, some higher competent departments approve the construction of illegal "legal" projects in the scenic spot by means of power, and the competition for economic interests is very fierce, resulting in serious damage to the scenic spot resources and ecological environment [6].

Organic reconstruction of terraced soil should be based on the terrain to determine the size of the field, cannot be cut. The length of the field is more equal to the short distance of the natural encroachment ditch, the short distance of the immersion ditch is large, the field is not long, and the other way around is short. However, for a few branch furrows, if the simple distance is small, shallow and narrow section, it can also be 1 flat to increase the length of the field to facilitate cultivation. The width of the field surface is increased with the height of the twist. However, according to the different steep and warm slopes and the thickness of the soil layer, the general characteristics of building terraces are: the more the slope, the thicker the soil layer, the higher the terrace surface and the lower the twist surface; on the contrary, the steeper the slope, the thinner the soil layer, the narrower the terrace surface. According to the different slope of the field, there are horizontal terraces, slope terraces, compound terraces and so on. The width of the terraces depends on the slope of the ground, the thickness of the soil layer, the cultivation method, the amount of labor and economic conditions [7, 8].

Organic soil reconstruction of horizontal terrace: the surface of the field is built into a horizontal ladder farmland along the contour line, and the soil thickness and level of the field are raised or pushed flat, which is also a good way to preserve water, soil and increase production.

Physical and organic soil reconstruction of slope terrace: Slope terrace refers to a kind of dry land in which the ridge on the slope of the hill is in the shape of a ladder and the block is in the shape of a slope. It was gradually transformed from sloping farmland. In order to reduce the amount of soil and water loss in sloping farmland, the rock ridge is built at the suitable position to form the prototype block, and the ridge is gradually increased and the slope in the block is gradually reduced, so as to increase the infiltration amount of surface runoff and reduce ground erosion. In many places, mulberry and yellow flowers are planted on the edge ridge, which not only strengthens the ridge, increases the income, but also improves the effect of soil and water conservation. When conditions permit, slope terraces should be transformed into horizontal terraces.

Organic reconstruction of soil physics of compound terrace: compound terrace refers to the combination of horizontal terrace, slope terrace, slope terrace and other forms of terrace opened on the slope of the hill according to the situation of the mountain and local conditions. It should be built through overall planning, and can also be combined with water and soil conservation projects such as horizontal gully under necessary conditions to improve the water retention and corrosion resistance of slope cultivated land. Building compound terrace can make more rational use of land, save project investment and improve soil and water conservation efficiency.

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Physical and organic reconstruction of the terraced land on the other slopes: this slope can also be used as a catchment area for the next level of horizontal terraces, where crops are grown on the horizontal terraces, and grass and water are collected on the slope. The width ratio between horizontal terrace and slope is generally 1:1.

Terraced field can adapt to various complex terrain conditions, and is convenient for winter and spring idle season. The ridge of terrace should occupy a certain amount of arable land, so that the arable land area is reduced accordingly, in order to make full use of land, crops can be planted on the ridge, such as pumpkins, yellow flowers and broad beans.

In addition, the management and maintenance of terrace is an important link to give full play to the role of terrace. It is found that there are loopholes, slumping, subsidence, stamping and other problems should be repaired immediately, so as to pay equal attention to management and maintenance.

2.2. Soil biological reconstruction design

The water resources available in the project area mainly include surface runoff generated by rainfall and small reservoirs 1.2 km away from the project area. The project area has a unique geographical structure. The cultivated land in the project area is distributed in the middle and lower part of the mountains. Numerous forests and secondary forests in the alpine area store a large amount of water in the soil with roots, which can trap precipitation, enhance soil infiltration, reduce ground transpiration and alleviate surface runoff, forming a huge natural green reservoir. In the dry season, the forest releases water storage, prolongs the runoff time, and makes the mountain streams in the project area run water all the year round. It can be said that without numerous water source forests, there would be no Longsheng terraces. Therefore, the existence of vegetation resources plays a huge role in terrace engineering, and it is imperative to carry out soil bioengineering. The methods for soil bioreconstruction in terrace are as follows:

When there is sufficient stone material or a large amount of gravel in sloping farmland, it is necessary to make use of the advantages to build horizontal terraces of stone sills. For areas with deep soil layer and abundant local labor, horizontal terraces must be built at one time. In the sloping land where the soil layer is thin or the local labor is less, slope terraces can be built first, and the slope of the field can be slowed down by turning the soil down year by year to gradually become horizontal terraces. In places where there is a small number of people on the land and a lack of labor, and where the annual rainfall is low and the slope of the cultivated land is 15º ~ 20º, slope terrace can be used to grow crops on the platform and pasture on the slope. In rainstorm, surface runoff on the slope can be used to increase soil moisture on the platform.

The purpose of organic soil reconstruction in Longsheng terrace is to increase the structural stability of terrace. Through the organic land reconstruction, the effective area of the terraces is increased, but the quality and stability of the terraces are improved, and the damage to the terraces by natural factors and perceived factors is reduced. Because the ridge of terrace is immersed in water for a long time, it is easy to slip and cause local instability. Therefore, the stability of the ridge is specially checked. In the calculation of the stability of terrace, two conditions are also used to compare, namely, the stability of terrace under natural state and the stability of terrace under rainfall. In the analysis of local stability of terrace, the selection of ridge is related to the overall stability of terrace, and the ridge where the terrace connects to the slope is at the most likely slip surface of terrace. In order to ensure the stability of the ridge, the two levels of ridge with the highest elevation of terrace are selected as the research target.

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3. Benefits of the project

The Long sheng terrace renovation project will implement the comprehensive management of "field, water, road, forest and village", which will carry out the comprehensive renovation of the field, water and road respectively, repair the collapsed and abandoned fields, improve the irrigation and drainage systems, and rebuild the scenic roads. The improvement of farmland facilities and conditions will reduce the degree of field fragmentation, improve the utilization level of cultivated land, and improve the regional planting, production and ecological environment. It forms a local microclimate and plays an ecological service function such as water conservation, soil conservation, air purification, biodiversity protection and landscape recreation. The development of the terrace project has achieved great economic, social and ecological benefits.

3.1. Conserve water sources

Due to heat, labor and traditional production methods, Long sheng rice terraces generally only grow rice in one season, and the rest of the land is generally used as leisure. This approach not only lays the foundation for the sustainable use of soil nutrients for the next year's paddy production, but also saves water for production. Based on the calculation that the water consumption of dry matter production in rice production is 680 g /kg, and the water requirement for rice production is about 6120 m^3/hm^2 per season, Long sheng terrace saves 3,363,900 m^3 of water, which is also transferred to the underground or the atmosphere and stored in the terrace ecosystem in the form of water resources. In addition, this way of fallow and rejuvenating farmland use to maintain land capacity is conducive to more time in the year to fully play the function of the terrace invisible reservoir, regardless of the growth status of the crops in agricultural production.

3.2. Soil Conservation

The terrace reduces the slope of the field because of changing the micro-topography, and the ridge cuts off the slope, cuts off the slope runoff, slows down the runoff speed, weakens the slope erosion and increases the rainfall infiltration time, so as to realize the function of the terrace to reduce soil and water loss. Terraces can intercept 70 to 95 percent of surface runoff and 90 to 100 percent of sediment. Using terraced water storage, from the end of June to the middle of July, the depth of irrigation can reach 20 cm, and the terraced water storage capacity is 10,065,500 m^3. The intercepted water enters several cycles: one is the small cycle, that is, the cycle in the terrace ecosystem, including soil infiltration and storage, replenishment and irrigation in the dry season, and finally consumption in evapotranspiration; The second is the big cycle, that is, the regional water cycle, this part of the water in the form of surface runoff or underground runoff concentrated in the mountain stream, and finally into the capital water. Because the small circulation path of water in Long sheng terrace is smooth and the accumulation amount is large, the large circulation in the region is weakened, and the total amount of river runoff is reduced. In other words, the Long sheng terraces are like layered reservoirs, storing surface water underground or transferring it to the atmosphere through leakage and transpiration, which not only reduces the possibility of flash floods, but also stores enough water for local production and life.

4. Conclusion

Terracing project is an important measure of slope farmland management in China. The aim of project design is to improve farmland intensification and water utilization. Improve water supply and drainage, power channels and other supporting facilities; Increase the effective arable land area and improve the land quality level. Through the implementation of the project

to improve agricultural production conditions and regional ecological environment, increase the agricultural income of the local people, form an industrial structure and growth mode that saves energy and resources and protects the ecological environment, significantly improve the quality of the ecological environment, and provide a good ecological guarantee for the construction of a resource-saving and environment-friendly society. To enable the broad masses of people to produce and live in a good ecological environment, to achieve sustainable economic and social development, and to achieve sustainable development of agricultural resources, is of great significance for the construction of local ecological civilization.

In order to maximize the protection of terrace culture, the project mainly adopts ecological and green construction methods. The design mainly focuses on the concept of "mountain is the life, water is the lifeblood, landscape is the soul, terraces are the eyes", emphasizing that the restoration and protection project of natural landscape of terraces will carry out comprehensive remediation of fields, water and roads, repair the collapsed and abandoned fields, build a 300,000 m3 reservoir on the top of the terraces, improve the irrigation and drainage systems, and rebuild the scenic roads. In the construction method, with the artificial original technology, combined with modern technology, emphasis on "local materials" and strive to "repair the new as old". For example, the restoration of the terrace wall, will use the method of wooden piling and mud ramming, road construction will be fully laid SLATE road, with these ecological, green and environmental protection construction methods, to solve a series of problems in the protection of the terrace, so that the natural landscape of Long sheng terrace can be permanently and well preserved.

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