

Research Progress on Ecological Safety Guarantee Technology for Gully Improvement in the Loess Plateau

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Abstract: Since the implementation of the project of returning farmland to forests and grasslands in the Loess Plateau area, the vegetation coverage has increased significantly, the sediment entering the yellow has been greatly reduced, and the ecological situation has been significantly improved. However, after the conversion of slope land to forest and grassland, the area of cultivated land has been greatly reduced, and the relationship between "people and food" has become tense in some places. And with the increase of rainfall in recent years, there have been ecological risks and safety hazards such as slope-vegetation system instability, slope landslides, trench filling settlements, and dam chain failures. Therefore, integrating the ditch-slope comprehensive treatment technology with the function of ecological security guarantee, and constructing the complex system of ditch-slope treatment engineering is the main path to deepen the ecological security guarantee of the ditch and slope treatment engineering, which will provide great support for ecological restoration and farmland construction. And provide technical support for increasing the area of cultivated land.

Keywords: Loess Plateau, Land Slope, Body-vegetation system, Slope landslides, Trench filling settlement, Ecological restoration.

1. Introduction

Affected by water and wind erosion, the Loess Plateau has serious soil erosion, and the situation of water and soil loss is severe. Soil erosion and the destruction of the original ground vegetation deteriorate the ecological environment, aggravate the drought of the land and microclimate and the occurrence of other natural disasters, resulting in barren land, decreased fertility, and damage to agricultural production; at the same time, soil erosion enlarges the scale of gullies. A large area of sloping cultivated land is fragmented, making it inconvenient to cultivate, and even the cultivated land is abandoned, resulting in a decrease in cultivated land. The statistics provided by the Ministry of Water Resources show that in the past half century, my country's water and soil erosion has destroyed 2.67 million hm² of cultivated land, directly affecting the development of farmland capital construction and agricultural production. In addition, severe soil erosion has weakened soil fertility, resulting in low and unstable food production.

Loess hilly and gully areas are key and difficult areas of ecological construction in my country. Over the past 30 years, through the implementation of a series of projects such as comprehensive management of small watersheds, returning farmland to forests, construction of check dams, and land reclamation, vegetation restoration and soil and water conservation have achieved remarkable results. After returning farmland to forests, the microclimate caused by the change of the ecological environment has led to increased rainfall and severe loess landslides in the loess hilly and gully areas. Therefore, it is of great significance to deepen the major theory, engineering technology and typical demonstration research on ecological security guarantee of channel and

slope improvement projects for the implementation of comprehensive watershed management projects and the prevention and control of ecological disasters.

2. Construction of Check Dams on the Loess Plateau

The check dams store the sediment on the spot, turning barren ditches into artificial small plains and increasing the area of cultivated land. At the same time, the dam land is mainly formed by the siltation of the surface soil layer lost on the slope of the small watershed, which contains a large amount of organic matter such as livestock manure, litter and leaves. The soil is fertile, has sufficient water, and has strong drought resistance. The check dam is an effective measure created by the people in the Loess Plateau area in the long-term struggle against soil erosion to stop mud and flood, maintain water and soil, and build fields from silted land. Water resource utilization, promotion of agricultural conversion, structural adjustment and economic growth, and improvement of transportation and living conditions in hilly and mountainous areas have played a key role. The earliest check dams in the Yellow River Basin were formed due to natural landslides.

As a unique soil and water conservation measure on the Loess Plateau, check dams have drawn extensive attention from soil and water conservation scholars in my country. Li Jing, Zheng, et al. (1995) believed that check dams are the main measures for channel management, and the amount of sediment reduction in dam reservoirs is about 60%-70% of the total sediment reduction by soil and water conservation measures. The siltation of the dam raises the base level of erosion, which can prevent the incision of the channel and the expansion of the channel rock. Wang Hong et al. (1997) used the "genetic method" to calculate the sediment

and flood reduction benefits of the southern check dams in the Helong section: the average annual flood reduction was 22.84 million m³ in the 1950s and 1960s, 38.29 million m³ in the 1970s, and 33.98 million m³ in the 1980s, the benefits are 2.78%, 6.89%, and 7.77%, respectively, and the corresponding periods of average annual sediment reduction are 14.51 million t, 25.13 million t, and 22.89 million t, and the benefits are 5.47%, 13.4%, and 20.4%; Among the total reduction, the flood reduction affected by check dams accounted for 80.8%, 67.6%, and 54.2% in each period, and the sediment reduction accounted for 83.5%, 58.5%, and 66.4% in each period. Fang Xuemin et al. (1998) systematically analyzed the sediment retention mechanism of the check dam, and believed that the check dam not only blocked the high-sediment flow, but also reduced the channel gradient. According to the observation of the Wuding River Basin, the original channel gradient The average is 2.02%, and the average gradient is 0.25% after the dam is formed. It is concluded that the mechanism of silt retention and erosion reduction of silt dams is mainly manifested in: local elevation of erosion benchmarks, weakening of gravity erosion, and control of gully erosion development; retention of flood sediment, reduce gully erosion; slow down surface runoff, increase surface silt; increase dam land, increase agricultural yield, promote steep slope conversion of farmland to forest and pasture, and reduce slope erosion. Tian Yonghong et al. (1999) analyzed the measured rainfall, runoff, sediment and different watersheds and concluded that there were 263 check dams in the Jiuyangou watershed. From 1953 to 1997, the total amount of check dams was 20.085 million tons, and the annual average Block 456,500 tons of sand. At present, the average annual sediment reduction benefit of the channel dam system is 78.6%. The sediment transport modulus of the watershed has dropped from 18,000 t/km² before treatment to the current 2060 t/km². The flood sediment is basically under control, and the dam system is close to being relatively stable. Xu Xiangzhou (2009) compared the results of the model test methods of the channel dam system on the Loess Plateau and showed that the effect of retaining sediment and silting land of the channel dam system on the Loess Plateau is closely related to the order of dam construction: "down first, then up", "main first, then branch". "The dam layout scheme is superior. The results of the single dam discharge simulation test and the dam system rainfall simulation test confirmed the existence of relative stability. Factors such as the expansion of the dam area and the self-balancing mechanism of the channel are the main reasons for the relative stability of water and sediment in the check dam. Gao Haidong et al. (2016) comprehensively analyzed the impact of check dams on the Loess Plateau on the hydrological process, vegetation distribution, and erosion and sediment production in the watershed, and found that the channel treatment project significantly changed the hydrological processes such as watershed transpiration, soil water redistribution, and surface runoff; The ecological and hydrological situation of the watershed is affected, which in turn affects the temporal and spatial distribution of vegetation; the local vegetation coverage is increased, and the diversity of plant communities is increased, but the range is small; the sediment is effectively stored, and the sediment transport ratio of the watershed is significantly reduced. The regulating effect of check dam deposition process on the stability of valley slope and soil erosion modulus was quantitatively analyzed. With the increase of the siltation height of the dam, the extremely unstable area of the watershed gradually

decreases, while the extremely stable area gradually increases. Based on the ecological and hydrological effects of water and soil conservation in the watershed, the concept of soil erosion control degree was proposed and the potential for watershed erosion control was studied. The maximum amount of suitable water and soil conservation measures that the watershed can accommodate is called the capacity of water and soil conservation measures, which reflects the water and soil conservation governance potential of the watershed.

3. Research Progress on Ecological Security Guarantee Technology for Slope Improvement on the Loess Plateau

The Loess Plateau is an important source of oriental civilization, and it is also the area with the most serious soil erosion in my country and even in the world. Controlling soil erosion and improving the ecological environment are not only the needs of local social and economic development, but also the needs of the country's long-term stability.

(1) Function and means of slope management

The role of the slope management project is to prevent soil erosion on slopes by changing the terrain, to store rainwater and snowwater on the spot, so that they can infiltrate into farmland, grassland or forest land, reduce or prevent slope runoff, and increase the yield of crops, pasture and forest trees. available soil moisture. At the same time, the slope runoff that cannot be stored locally is introduced into small water storage projects. On slopes where there is a risk of gravity erosion, drainage works or supporting buildings can be built to prevent landslides. The purpose of the slope improvement project is to eliminate the runoff generated on the slope, store infiltration on the spot, use the water and soil resources on the spot, and increase the land for agriculture, forestry and pasture, especially the ability to resist cold. According to the terrain, soil quality, and land type, certain engineering measures are reasonably arranged on the slope, and the farmland, forest grassland, and water storage projects are organically combined with channels, roads, and forest belts to form a complete system of storage, infiltration, diversion, diffusion, and water storage. The combined protection system of irrigation and drainage enables the afforestation and grass planting on barren hills and barren slopes, strip fields on gentle slopes, twisted fields, horizontal terraces, horizontal precipitation steps on steep slopes, horizontal ditches, and various water storage and soil conservation, afforestation and land preparation on slopes. The projects cooperate with each other to form a whole. Slope treatment engineering generally includes biological engineering, agricultural engineering and water storage engineering.

(2) Small watershed comprehensive management model

1. Allocation model of comprehensive control measures for typical small watershed slopes in hilly and gully regions

The Ducha small watershed in Mizhi County, northern Shaanxi is a secondary tributary of the Wuding River, and belongs to the first sub-region of the hilly and gully region of the Loess Plateau. According to the principle of adapting measures to local conditions and comprehensive management, the comprehensive control measures for the slope in the Chacha small watershed are aimed at protecting and rationally developing and utilizing water and soil resources, improving the ecological environment, and developing the economy of small watersheds. According to the natural conditions of the

small watershed, the slopes are divided into Liangmao slopes and valley slopes. On the gentle slopes, horizontal terraces are mainly built, supplemented by orchards, planting forests and grasses, building water cellars, rainwater harvesting fields, and laying shrub belts beside the sieve. A small amount of cultivated land adopts grass field rotation, horizontal ditches and ridges planted on relatively gentle and complete valley slopes, and adopts engineering land preparation measures such as horizontal ditches, horizontal terraces, reverse slope terraces and fish scale pits to create economic forests and timber forests. On the ground, plant shrubs dominated by caragana.

2. Allocation model of comprehensive control measures for typical small watershed slopes in plateau gully areas

The Yaergou small watershed in Changwu County, Shaanxi Province is a typical plateau gully area. Since the 1970s, it has been comprehensively controlled, and various measures have been gradually improved, and comprehensive control of water and soil conservation has been carried out. By 1985, a total of 2,150.33hm² of horizontal land had been repaired, 117 protective forest networks on the source surface, totaling 585km, 40.4km of ditch side ridges, 16 ditch head protection projects, 20km of sourceside protection belts, and 549.13hm² of horizontal terraces on the front slope were built. A total of 1059.87hm² of shelterbelts will be constructed mainly of Robinia pseudoacacia. Build 2 small reservoirs, 55 check dams, 17 Liugufang, and build a certain number of anti-scour forests at the bottom of the ditch. Before and after treatment, the erosion decreased by 73.7%, and the runoff decreased by 49.93%, which played a role in water storage (Liu 2004).

4. Conclusion

Summarizing the current development status of slope surface control technology at home and abroad, combined with the characteristics of soil erosion in the small watershed of the Loess Plateau, not only a comprehensive study on the slope surface control plan of the Loess Plateau, but also an in-depth study on the configuration of control measures, in order to establish a scientific control system, to improve the benefits of slope management on the Loess Plateau.

Slope management on the Loess Plateau is also an important way and means to ensure the ecological security of the Loess Plateau region. In-depth research on slope management has a certain guiding role and practical significance for ecological restoration and farmland improvement in gully areas on the Loess Plateau.

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