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Research on Ecological Problems and Restoration in Alpine Region Technology

Yan Li[1,2,3,4,5,*], Yuhu Luo[1,2,3,4,5]

[1]Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710021, China

[2]Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China

[3]Land Engineering and Human Settlements, Shaanxi Land Engineering Construction Group Co., Ltd and Xi'an Jiaotong University, Xi'an 710075, China

[4]Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources, Xi'an 710075, China

[5]Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi'an 710075, China

Abstract

The Qinghai-Tibet Plateau has a cold and arid climate and a sensitive and fragile ecological environment. It has environmental conditions and potential factors for the development of desertification and barrenness, and is closely related to changes in land, climate and vegetation. The paper analysed the ecological environment problems and causes in the alpine zone of the Qinghai-Tibet Plateau from the aspects of natural environment and human activities. In this regard, measures such as restoration of degraded grassland vegetation, ecological restoration, and prevention of disasters and epidemics are put forward, which can provide reference for the research on the prevention and control of degraded land and the improvement of ecological environment in the alpine zone.

Keywords

Alpine Region; Land Retirement; Vegetation Restoration; Mining Area.

1. Introduction

The alpine steppe is mainly distributed in most areas of the Qinghai-Tibet Plateau, most of which are above 4000 m above sea level. It mainly includes the broad valley of the plateau in the source region of the Yangtze River and most of the Qiangtang Plateau. The vegetation is represented by alpine grasslands, where many forages grow, and it is an important animal husbandry industry base on the Qinghai-Tibet Plateau. The alpine steppe zone can be divided into the Nagqu-Maduo Plateau meadow eco-region, the Qiangtang Plateau-the source of the Yangtze River alpine steppe eco-region, and the Northern Qiangtang Plateau-alpine desert steppe eco-region. The land utilization in the alpine zone has two characteristics. One is that the land use type is dominated by pasture and the coexistence of agriculture and animal husbandry; the other is that the land use mode has obvious vertical differentiation characteristics. In the middle and upper parts of the mountains, there are large areas of grass felt soil, black felt soil, cold calcium soil, cold calcium soil, cold desert soil and other alpine soils. At present, research on land degradation and ecological restoration in Alpine Regions mainly focuses on degradation classification and cause identification, ecological restoration theory, restoration techniques for degraded ecosystems, and ecological animal husbandry

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development, and has achieved a number of high-level research results and advanced theoretical techniques.

2. The Ecological and Environmental Problems and Causes in the Alpine Utilization

2.1. Harsh Natural Environment and Fragile Ecology

The Qinghai-Tibet Plateau is the region with the largest distribution of glaciers in the middle and low latitudes in the world, and modern glaciers account for more than 80% of the glacier area in my country. With global warming, the dramatic retreat of plateau glaciers and snow cover has become the general trend of regional glacier changes. The retreat of glaciers changed the regional climate process, and the temperature generally rose, with a temperature increase rate as high as 0.1-0.3°C/10a, while the precipitation in most areas showed a decreasing trend, with a decreasing rate of 10-40 mm/10a, especially in summer [1]. With the increase of temperature and the decrease of precipitation, the evaporation of the plateau increases and the surface runoff decreases, the soil becomes dry and the anti-corrosion ability weakens, which in turn affects the growth of vegetation, causing vegetation degradation and land wind erosion and desertification.

2.2. Serious Degradation of Grassland

Extensive and rapid land degradation. The Alpine Region of the Qinghai-Tibet Plateau is the largest alpine grassland ecosystem in the world, and it is also an important pastoral area in my country after the Inner Mongolia Plateau. However, due to factors such as long-term overloading, overgrazing, and rodent damage, the grassland has been seriously degraded. According to literature data, the total area of degraded grassland on the Qinghai-Tibet Plateau is about 50 million hm^2, which is equivalent to 1/3 of the available grassland. Among them, the degraded grassland of alpine meadow is 16.2 million hm^2, accounting for 32.4% of the degraded grassland in the whole region.

Severe rat disaster. Grassland rodents in vulnerable alpine areas are seriously infested. They not only compete with livestock for grass, but their excavation activities also cause serious damage to grassland vegetation. After grassland degradation, vegetation coverage declines and poisonous weeds grow, coupled with activities such as human hunting and killing of wild animals, so that in the food chain such as plant-rat-fox-wolf and plant-rat-eagle, there are originally relatively small numbers of secondary and advanced food chains. The number of consumers and the scope of their activities have been greatly reduced, resulting in ecological imbalances, providing a good environment for the migration, survival and reproduction of rodents, resulting in excessive breeding of rodents. It is estimated that there are at least 600 million pikas on the Qinghai-Tibet Plateau, and the annual consumption of pasture exceeds that of livestock. In the rat-infested area, there are generally 2,700 rat holes/hm2 in the grassland, and as many as 4500 to 5700 pcs/hm^2 in severe areas [2]. The rampant activities of rodents directly lead to the rapid destruction of the soil structure of the meadow. Under the action of freezing and thawing, wind erosion and water erosion, the turf layer collapses, forming "black soil beach", "black soil slope" and grassland desertification, etc.

2.3. Unreasonable Human Activities Exacerbate Ecological Degradation

Excessive and random *mining of Chinese herbal medicines*. The Qinghai-Tibet Plateau is home to valuable medicinal plant resources such as *Ophiocordyceps sinensis* and the excavation of medicinal materials has also caused great damage to the grasslands. Random digging of medicinal materials and sand-fixing plants has led to the excavation of the sand-fixing plants, resulting in varying degrees of wind erosion, degradation and desertification in the growing areas of medicinal materials.

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Tourism activities affect the grassland ecological environment in vulnerable areas. The development of tourism in Alpine Regions has unique advantages and great potential. The growing tourist population has put enormous pressure on the environment, with pedestrian trampling and vehicular traffic causing grassland degradation in some areas. Under the trend of increasing tourist population in the future, the ecological and natural environment of the alpine and vulnerable areas will face more and more serious pressure, which may further aggravate its barrenness.

The impact of mining in the mining area is great. Unreasonable mining activities in mining areas in the alpine zone led to landscape damage, vegetation damage, land excavation and compaction, permafrost damage, water system wetland damage and mining pit water accumulation, groundwater aquifer damage, land desertification and soil erosion, unstable slopes and other issues [3]. For example, comparing the vegetation coverage in the Muli mining area before mining in 2001 and after mining in 2019, the proportion of alpine meadow area in the total mining area decreased from 93.98% in 2001 to 6.56% in 2019; 1.42% rose to 88.02% in 2019. The average vegetation coverage (FVC) decreased from 0.89 to 0.29, and the average vegetation index (NDVI) decreased from 0.67 to 0.37[4].

3. Research on Ecological Restoration in Alpine Regions

3.1. Improvement and Restoration of Degraded Grasslands in Alpine Regions

Grassland rejuvenation. Grassland rejuvenation is based on maintaining the original vegetation as much as possible, through fencing and artificial disturbance of the turf layer to improve soil permeability, to achieve the purpose of improving grassland production performance and promoting grassland restoration. Among them, fence enclosures are constructed in degraded grasslands, which can effectively prevent people and livestock from entering the enclosure areas, and are generally used for mildly and moderately degraded grasslands. Mildly degraded grasslands generally recover to their original state after 2-3 years of enclosure, while moderately degraded grasslands take 5-8 years [5]. Severely degraded grasslands, due to the almost disappearance of fine forages in the grassland plant community, and the extremely low ability of natural reproduction and renewal, it is difficult to restore to the initial state in a short period of time only by enclosure. And other improvement measures to carry out the configuration of artificial communities.

Replanting and improvement of grassland. The soil surface of alpine meadow grassland often forms a tough and dense layer of grass root flocs, which reduces the permeability of the soil and the excellent forage with high nutritional value, so as to increase the coverage, yield and quality of the grassland. Grassland re-sowing should first be done with ground treatment, followed by the selection of appropriate sowing methods, and finally, attention should be paid to post-sow management. In particular, seed coating and water-absorbing agent treatment should be carried out for reseeding forage seeds. Sowing can choose manual seeding, strip seeding and machine-guided or horse-drawn seeder supplementary seeding.

Prevention and removal of poisonous weeds and weeds. In the degraded grasslands of the Qinghai-Tibet Plateau, the main types of poisonous weeds are Acanthopanax japonica, Drunken horse grass, and wolf poison. Wolf poison is a poisonous plant with strong vitality, which has a strong inhibitory effect on the growth of fine pastures. Manual excavation or drug elimination methods should be adopted for such degraded grasslands. When excavating manually, it should be noted that the excavation range should not be too large. After excavating the main root, it should be covered with soil and filled with good forage grass in the pit. When the drug is eliminated, a selective drug should be used for cluster spraying, but it must be continuously eliminated to be effective.

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3.2. Comprehensive Management of "Black Beach" Grassland

The native (indigenous) vegetation of the severely degraded "black beach" has been almost completely destroyed. The vegetation coverage is about 20%. The remaining vegetation is sparse, mainly poisonous weeds and weeds that livestock are unwilling to eat, and the proportion of fine pastures is less than 10%. The grassland presents a large patchy bare land, the turf layer is damaged, and the soil has been degraded due to rodent damage or wind erosion, water erosion, etc., and loses the value of grazing. The natural restoration of this kind of grassland by fencing takes a long time, the effect is slow, and even difficult to reverse, and perennial artificial forage should be planted to rebuild the grassland vegetation.

Severely degraded grassland for moderately degraded grassland with vegetation coverage of 30% to 50% and biomass composition poisoning weeds accounting for more than 50%, grazing semi-artificial grassland can be built by reseeding pasture. The selection of grass species is mainly from Chinese fescue, Xingxingcao, cold land bluegrass and flat-stemmed bluegrass, and appropriate mixed grass species are sown [6]. The vegetation coverage of mildly degraded grassland is greater than 70%, the proportion of poisonous weeds in the biomass composition is less than 30%, and the turf layer is basically intact, and the vegetation should be restored mainly by the self-repair of the plant community. Measures such as erecting scaffolds to kill rodents and seasonal enclosures can be taken to reduce grazing intensity.

3.3. Ecological Restoration of Mining Areas in Alpine Regions

The restoration of vegetation. In the early stage of ecological restoration in mining areas, off-site maintenance of native turf and post-harvest replanting are effective measures for rapid restoration of damaged land vegetation. In the process of land restoration, matrix improvement is the core, and the method of "leveling and live broadcasting" is the most effective and low-cost. Strictly prohibiting grazing and applying fertilizers to the damaged land during the restoration process are important measures for later management.

Vegetation restoration on slopes of abandoned mines. The slope vegetation restoration technology is theoretically supported by the basic principles of restoration ecology, environmental ecology, landscape ecology, ecological engineering, botany and soil and fertilizer science. To gradually improve its resistance and resilience against external disturbances. Ultimately, a stable and healthy plant community will be established to play its due ecological function. At the same time, the purpose of stabilizing the slope, maintaining biodiversity and improving the environmental quality of the restoration area is achieved. Gao[7] et al. proposed a technical system of slope vegetation restoration in abandoned mine land, the core of which is mainly divided into three aspects: pioneer plant screening, plant habitat reconstruction and soil matrix improvement. In the mine slope vegetation restoration project, the principle of "suitable trees for suitable sites, and measures to local conditions; ecological management should be given priority, and engineering measures should be supplemented". For different geographical locations, climatic conditions, slope types and restoration goals, different technical combinations and construction methods can be flexibly selected to achieve the purpose of stabilizing slopes, reshaping habitats, rebuilding communities and restoring vegetation. At present, the widely used and promising slope vegetation habitat construction technologies in China mainly include mixed spraying type, hanging net laying type, lattice filling type, prefabricated trough type, etc. Different slope types can be selected for different vegetation restoration. Technology combination model.

4. Conclusion

Ecological restoration in the alpine zone involves multiple disciplines and fields. Studies have shown that in the alpine zone, due to the harsh climate, fragile ecology, and flooding of rat

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plagues, it is difficult to prevent and control soil degradation and the treatment cycle is long. For degraded grassland, the grassland environment can be restored through replanting, rejuvenation, weed control, and pest control. For the abandoned mining area in the alpine zone, the comprehensive use of landform remodeling, soil reconstruction, vegetation restoration, slope protection and other technologies is used to restore the vegetation in the abandoned mining area, improve the ecological environment, and beautify the mining area landscape. With regard to land degradation, vegetation decline, and disaster prevention in the alpine zone, it is necessary to further strengthen theoretical research, establish a technical system, and condense engineering application experience.

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