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Design Principle and Prospect of Saline-alkali Land Remediation Project

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Abstract

Soil salinization has always been a worldwide problem. Saline-alkali land remediation should be carried out according to local conditions according to the characteristics of different types of soil salinization and obstacle degree, the occurrence and evolution of saline-alkali environment factors and human factors. It is necessary not only to improve the current salinization soil, but also to prevent the occurrence of soil secondary salinization. In this paper, the design principles and ideas of saline-alkali land remediation project are summarized by referring to literature and combining with years of practical experience of land remediation. Taking the example of saline-alkali land remediation in typical inland areas as evidence, the key points and difficulties of each single project in the process of saline-alkali land remediation are expounded, and the key points in the ecological treatment and utilization of saline-alkali soil and the prevention and control of salinization are prospected in the future, in order to provide theoretical support for the research and development of the ecological treatment technology of saline-alkali land in China.

Keywords

Saline-alkali land; Governance improvement; Design principles; Technical difficulties; Research progress.

1. Introduction

In recent years, with the rapid development of urbanization and industrialization, the demand for land is increasing day by day, and the original land resources with small per capita occupancy become more scarce. As a resource for urban development, the contradiction between supply and demand of land is increasingly acute, and the problem of land use in agricultural development is particularly prominent. The country's food security and ecological progress are under serious threat [1-3]. Under the new situation and new tasks, how to make better use of the limited land resources through governance has become a major issue for the healthy, stable and sustainable development of the region.

As one of the important reserve land resources, saline-alkali land is distributed throughout the world's five continents. China is a large country with saline-alkali soil, covering an area of 34.61 million hectares, which is particularly large. About 7.6 million hectares of cultivated land have

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been salinized, with nearly one fifth of the cultivated land having been salinized [4]. Shaanxi Province has about 24,700 hectares of saline-alkali land, mainly concentrated in the Weinan area of Guanzhong and Yulin area of northern Shaanxi [5]. Lubotan saline-alkali land is an important representative of inland salinization problem in Shaanxi Province. The regional topography is low and long-term accumulation of salt has formed inland saline-alkali land, which is the most concentrated saline-alkali land in Guanzhong area of Shaanxi Province. This area was once called "green forbidden zone" for its poor ecological environment and low utilization value before renovation [6,7].

The existing cultivated land area in Shaanxi Province is becoming increasingly tight, and the difficulty of balance between occupied and replenished is increasing. Therefore, the development and utilization of saline-alkali land is of great significance to ensure regional food security and ecological civilization construction. The horizontal and vertical redistribution of various soluble salts in saline-alkali land leads to the gradual accumulation of salt in the soil surface of salt-collecting area, which affects the normal growth of crops [8-10]. How to "turn waste into treasure" of saline-alkali land into utilizable land resources is the main ecological and environmental problem facing dryland agriculture at present, and is also an effective way to relieve the shortage of land resources [4,11,12]. This study takes the Lubotan saline-alkali land remediation project of Shaanxi Province as an example, summarizes the design principles and ideas of saline-alkali land remediation project, analyzes the key and difficult points in the process of saline-alkali land remediation, and finally puts forward solutions. The research results have scientific and practical guiding significance for the implementation of saline-alkali land remediation and rehabilitation project.

2. Design Principles and Ideas of Saline-alkali Land Remediation Projects

2.1. Planning and Design Principles

Saline-alkali land remediation is a systematic project involving a wide range of fields and comprehensive technologies, which is a unity of many individual engineering technologies interpenetration and organic combination. The main projects involved include soil organic reconstruction engineering and supporting projects, among which supporting projects mainly include field road engineering, irrigation and drainage engineering, farmland protection and ecological conservation engineering and other projects [13,14]. The design principles of saline-alkali land remediation project include: (1) Take the principle of high yield, high quality and high efficiency agricultural road. Adhere to the combination of economic, social and ecological benefits; (2) The principle of simultaneous development and protection. Unified planning and reasonable arrangement of irrigation and drainage facilities for the treatment of saline-alkali land, and the combination of irrigation and drainage; (3) Adapt to local conditions and centralize the principle of contiguity. Do irrigation and drainage system, road, forest belt layout and square field construction and land leveling combination, do a good job in accordance with local conditions, overall consideration, engineering layout and strive to achieve the minimum amount of engineering costs.

2.2. Design Ideas for Comprehensive Regulation of Lubotan Saline-alkali Land

The main measure of traditional saline-alkali land improvement is salt washing, but it has some problems such as large amount of fresh water resources consumed by salt washing and drainage, large area of drainage and irrigation project, high treatment cost, and high salinity water discharged easily cause secondary pollution to the receiving area. Therefore, to study new methods and measures for improving saline-alkali land, how to save capital, save resources and reduce secondary pollution are the key points and technical difficulties in the process of saline-alkali land treatment.

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Aiming at the problems of low-lying landform, poor drainage and long-term accumulation of salt in the typical inland saline-alkali land, a new model of comprehensive treatment of saline-alkali land in Lubotan area of Shaanxi province was put forward, which is "to transform drainage into storage, coexistence of water and land, and harmonious ecology". The core of saline-alkali land management should be changed from "drainage" to "storage", relying on the water level of storage ditch and the concentration of salt and alkali in the water, and relying on microcirculation in a small area to accelerate the exchange of water and salt, so as to change the distribution of salt in the soil, gradually press salt into the bottom of the soil to reduce the salt content in the arable layer and restore the ecology [15-17].

3. Design Principles of Each Iindividual Project

3.1. Soil Organic Reconstruction Engineering

According to the soil quality of different project areas, soil organic reconstruction engineering mainly includes land leveling engineering and tilled layer soil overlying engineering. According to the differences in the region's original topography, combined with the layout of roads and canals, reasonable division of land size; All fields strive to achieve the level of the field surface, the balance of earthwork, the minimum amount of earthwork, the reasonable allocation of earthwork, and meet the requirements of farming and irrigation and drainage, to ensure that the thickness of the tilled layer of the field reaches more than 20cm [18,19].

3.2. Field Road Engineering

The road layout is coordinated with the layout of fields, villages, canals and ditches. The road engineering planned by this project is divided into two levels: field road and production road. The road width of the field road is 4-4.5 meters, and the pavement structure is mainly concrete pavement and mud stone pavement. The road width of the production road is 2-2.5 meters, and the pavement is soil pavement (plain soil compaction). According to local conditions, the maximum longitudinal slope should be 8%, and the minimum longitudinal slope should be 0.4% to meet the requirements of rain, snow and water exclusion. The slope and turning Angle of the road are designed according to the terrain [20,21].

3.3. Irrigation and Drainage Engineering

Irrigation and drainage facilities should be coordinated with the layout of fields, roads and forests, and the irrigation and drainage methods of Luopo flat saline-alkali land are adopted for the renovation. The designed irrigation guarantee rate is 75%, and the specifications and standards of irrigation and drainage channels are determined according to the area controlled by irrigation and drainage channels [16,22]. The irrigation channels in the project area are arranged in two levels, using a "U" shaped section structure, and the fields are laid with wool channels covering the entire project area to meet the irrigation needs. According to the actual natural conditions, crop conditions, groundwater critical depth and control area is arranged on both sides of the field [23].

3.4. Farmland Protection Project

In order to prevent wind and fix sand, protect ditches and roads, reduce the impact of wind damage on agricultural production, and improve farmland ecosystem, the planting standard is to plant a line of trees along the field road and on both sides of the production road. According to the local climate and soil conditions, as well as considering the local afforestation experience, the tree species of Wutong trees with salt and alkali tolerance are selected [24,25].

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4. Conclusions and Suggestions

Although good progress has been made in the treatment of salinized soil, it is still necessary for scholars from different countries in soil, ecology, plant and agriculture to continue to explore and find more effective treatment measures to enrich the material and technical basis for the improvement and restoration of salinized soil. At present, the engineering, water conservancy, agricultural, biological and chemical measures of salinized soil control are adapted to local conditions and comprehensive utilization according to the needs of different regions and soil parent materials. In the future, the following problems should be paid attention to in the treatment and utilization of saline soil and the prevention and control of salinization.

(1) Establish and improve the concept of ecological management of saline soil. First, make full use of biotechnology to effectively expand the potential of salinized land use without increasing the input of engineering and improved materials; Second, develop and improve new ecological salt drainage and salt control engineering technical measures to reduce the disturbance of saline soil treatment on the surrounding environment; Third, apply the concept and method of smart agriculture to the treatment of salinized soil. According to the distribution characteristics of regional salt and alkali, differentiated input consumption is applied to achieve the fine management and precise salt control of land salinization, prevent the occurrence of secondary salinization, effectively improve the input-output efficiency of management, and avoid the pressure on ecological environment caused by management [11,26].

(2) In the process of saline-alkali land treatment, soil quality should be improved simultaneously, soil productivity and crop nutrient utilization efficiency should be improved, land productivity and resource utilization efficiency should be balanced, modern agricultural industrial structure adjustment should be promoted, and ecological environment in saline-alkali areas should be improved. First, the improvement process pays attention to the input of organic fertilizer, green fertilizer return to the field, the application of biochar based fertilizer, etc.; Secondly, nutrient management measures and salt improvement measures should be combined to reduce the amount of ammonia volatilization, nitrogen leaching and other nutrient losses in saline soil, activate the content of crop absorbable phosphorus in soil, and promote the absorption of crop nutrients.

(3) Strengthen the research and analysis of saline-alkali land management theory. The comprehensive treatment of saline-alkali land is a technology-intensive project involving scientific and technological exploration and comprehensive application of scientific and technological achievements. It involves many fields, disciplines and scientific research achievements, and is faced with many difficulties due to its large amount of engineering and heavy tasks. In order to comprehensively control saline-alkali land, grasp land development and consolidation, and realize land dynamic balance, we must rely on systematic and scientific theoretical system and standardized and efficient project management, and adopt powerful policies and measures and scientific mechanisms to ensure that the comprehensive control work is organized and implemented in a planned and orderly way.

(4) Establish long-term soil water and salt dynamic monitoring and quality evaluation system. In arid and semi-arid regions, salinization is always a problem. Soil salinity shifts in time and space under man-made action, which threatens the improved farmland ecological environment and the sustainable development of agriculture. Therefore, a long-term water and salt dynamic system should be established with the control area as the unit, and a professional laboratory should be established to conduct long-term observation and research on the distribution, evolution law and soil quality of salinized soil, so as to seek the best macro-ecological regulation model and environmental protection strategy. At the same time, with the rapid development of modern information technology, the correlation analysis of various crops, water, salt, soil and climate in saline-alkali soil management research has become a reality, and the occurrence of

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soil secondary salinization can be predicted and controlled more accurately, more conveniently and more scientifically through the digital and information processing of modern information technology.

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