Study on the Harm of Saline Alkali Land and Its Improvement Technology in China

Baoqiang Zhang1,2,3,4,* and Na Wang1,2,3,4

1Shaanxi Provincial Land Engineering Construction Group Co., Ltd. Xi'an 710075, China
2Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd. Xi'an 710021, China
3Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resource Xi'an 710021, China
4Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi'an 710021, China

*Corresponding author: zhangbaoqiang@shaanxidijian.com

Abstract. As a common soil type, saline alkali land is widely distributed in China. The soil properties of saline alkali land are relatively special, and the utilization rate is relatively low. In the current situation of scarce soil resources, the improvement of saline alkali land has attracted much attention, and it is particularly urgent to speed up the improvement and utilization of saline alkali land. The improvement methods of saline alkali land are different. This paper analyzes the causes of the formation of saline alkali land, discusses the current situation and harm of saline alkali land, comprehensively expounds the physical improvement methods, chemical improvement methods, biological improvement methods and combination methods of saline alkali land treatment, and further puts forward the development trend of saline alkali land treatment technology in China.

Keywords: Saline alkali land, Harm, Improvement, Method.

1. Introduction
Saline alkali soil is a kind of special soil formed by natural or man-made reasons, which is dry and has strong evaporation, and the salt content affects the normal growth of crops [1]. Saline alkali land is widely distributed in China, mainly in the northeast, North China, northwest and eastern coastal areas, with an area of about $9.913 \times 10^7$ [2]. China has a large population, less land and scarce cultivated land resources. The per capita cultivated land area is only 0.092hm$^2$, less than 40% of the world average. At present, China is in the stage of rapid development of industrialization and urbanization, and the demand for land is increasing, which makes the contradiction between man and land increasingly prominent. Therefore, in order to solve the problem of more people, less land and food shortage in China, it is urgent to supplement cultivated land resources and improve the utilization of saline alkali land, so as to make China's ecological agriculture develop efficiently [3].
2. The formation reason of saline alkali land
There are two main forms of saline alkali land, one is saline alkali land formed under natural conditions, the other is saline alkali land formed by human activities [4]. The original saline alkali land is due to the accumulation of soluble salt in the soil surface when it moves in the horizontal and vertical directions until it exceeds the normal level of soil salt content. The main influencing factors are hydrogeology, climate, topography and vegetation. Secondary saline alkali land is due to human activities, as well as the unreasonable use of natural resources, which makes the soil salinization. The main factors are unreasonable irrigation and deforestation.

3. The improvement status and harm of saline alkali land
3.1. Improvement status of saline alkali land
It is easy to harden the soil in the surface layer of saline alkali soil, which leads to the poor permeability of the soil and the decrease of the nutrient content in the soil, and the increase of the harmful ion content to the crops. Therefore, it is difficult for the crops growing in saline alkali soil to survive. Different environment will form different types of saline alkali land, which has a negative impact on the agriculture, animal husbandry and ecological environment of the region.

Due to the increasingly serious salinization, more and more soil in our country can not be used reasonably, the income of farmers can not be guaranteed, and the phenomenon of soil hardening caused by soil salinization, all these problems show that the improvement of saline alkali land is an urgent problem to be solved. Therefore, scientists in China have done a lot of research on saline alkali land management in China, and have made great progress and achievements.

3.2. Hazards of saline alkali land
Saline alkali land is affected by both natural conditions and human activities. Soil salinization is caused by water resources, climate, climate and unreasonable irrigation of crops by human beings. In addition, the changes of soil physical and chemical properties caused by soil salinization and alkalization lead to land collapse, salt expansion and other phenomena in some areas, which have adverse effects on engineering construction, resulting in huge economic losses. In addition, due to the high concentration of soil salt ions in saline alkali soil, it is difficult for crops to absorb soil water, which leads to the loss of plant water, damages the plant growth function and inhibits the normal growth of plants. After further deterioration, there will be large-area death of plants, which aggravates the soil desertification and seriously endangers the safety of environmental ecosystem [5].

4. Improvement methods of saline alkali land
The improvement and utilization of saline alkali land can not only increase crop yield and alleviate the food crisis, but also improve the agricultural ecological environment, so as to improve people's quality of life [6]. Scholars have done a lot of research on the physical and chemical properties and structure of saline alkali soil, and put forward targeted measures for different degrees of saline alkali soil. Saline alkali land improvement technology can be divided into physical improvement, chemical improvement, biological improvement and engineering improvement.

4.1. Physical improvement method
Physical improvement is to control the movement of water and salt by improving the physical structure of the soil, and take different improvement measures to reduce the concentration of soil salt or isolate the saline alkali soil, so as to achieve the purpose of improvement. Optimizing soil structure can reduce water evaporation and improve the leaching efficiency of soil salt. The commonly used physical improvement methods are soil method, surface film mulching, land leveling and tillage measures [7].

The viscosity of soil texture in saline alkali soil is relatively high, so the improvement measures of sand spreading in guest soil can effectively improve the saline alkali soil. With the increase of sand
spreading thickness in guest soil, the improvement effect of saline alkali soil is also constantly improving [8]. In addition to increasing the thickness of soil cover, sanding with guest soil can increase the use efficiency of soil water, reduce the loss of water, and reduce the salt accumulation in the surface of soil. Surface film mulching is the mulching of biological straw and plastic film on saline alkali soil, which can effectively reduce the salt content in the soil, prevent the loss of soil water, and inhibit the accumulation of salt on the surface [9]. Ploughing method is to plough the soil deeply before planting, loosen the surface soil deeply, and effectively improve the soil permeability. When the soil is deeply ploughed, the capillary in the soil is cut off, which effectively reduces the evaporation of water and inhibits the migration of deep salt ions to the surface of the soil [10].

4.2. Chemical improvement method

Chemical improvement method refers to the application of chemical amendments or mineral fertilizers to improve the physical and chemical properties of soil in saline alkali land, and the transformation, adsorption or fixation of saline alkali components in soil, so as to reduce the harm of soil salinization. It is found that humic acid, ferrous sulfate and calcium containing substances can be used as improvers of saline alkali land [11]. Chemical improvement is one of the important measures for saline alkali soil improvement in China, but different modifiers have different effective components, so the improvement principle and effect are also different, and it also has a certain impact on the changes of soil pH value, total salt content and ion composition [12].

Wang Qianzi et al. Showed that humic acid was used to improve saline alkali soil. The results showed that compared with the control, different humic acids had no significant effect on soil pH in the same season. However, the three humic acids all showed the effect of reducing soil electrical conductivity (EC), water-soluble Na\(^+\) and K\(^+\) content and sodium adsorption ratio (SAR). The influence depth is 0-40 cm soil layer [13]. Fan Dingkang et al. Studied the effects of desulfurized gypsum, ferrous sulfate, sulfur and aluminum sulfate on soil pH, electrical conductivity (EC) and biomass. The research shows that desulfurization gypsum has the best effect in reducing pH value, and its range of reducing soil pH value is 0.71-1.25, with the maximum reduction of 12.4%; followed by ferrous sulfate; sulfur and aluminum sulfate have no significant effect in reducing pH value [14]. Ningxiaoguang et al. Showed that under the condition of high salt, the yield of sorghum increased significantly by 8.1% when applying appropriate amount of superphosphate (375kg·hm\(^{-2}\)). And the experiment confirmed that SSP can provide sufficient nutrients for soil and improve soil quality, so it can be used as an effective modifier for saline alkali land [15]. Li Ximei and other studies showed that the mixed application of organic fertilizer and calcium superphosphate is a reasonable fertilization measure for high yield of Winter Wheat in saline alkali soil [16].

4.3. Biological improvement methods

Bioremediation consists of two parts: phytoremediation and microbial remediation, mainly phytoremediation. Phytoremediation is the improvement and restoration of saline alkali land through the selection of saline alkali tolerant plants, and microbial remediation is the improvement of saline alkali land through the application of microbial fertilizer [17]. Biological improvement mainly uses the salt tolerance of plants and microbial fertilizer to improve the soil salinization. Through the life activities of plants or microorganisms, it improves the soil structure, increases the soil porosity and nutrients, and better regulates the soil physical and chemical properties [18].

In the treatment of saline alkali soil at home and abroad, the planting of salt tolerant plants is widely used. This method makes rational use of saline alkali soil resources and promotes long-term effective agricultural production. It is an optimal method to improve saline alkali soil. Xiao Kebiao et al. Studied the biological improvement of saline alkali soil by different types of salt tolerant plants. The results showed that planting Tamarix, Festuca arundinacea and oil sunflower had the most significant effect on reducing soil bulk density in saline alkali soil (0-20cm), effectively reducing the total salt content in soil, improving soil fertility, and reducing the surface salt content by 6.4%, 71.5% and 46.1%, respectively, Surface soil organic matter increased by 73.7%, 38.2% and 21.3%
respectively [19]. Wang Dan et al. Studied the effect of microbial fertilizer on soil improvement and bacterial community of Lycium barbarum in saline alkali soil, and showed that the application of different kinds of microbial fertilizer significantly reduced soil pH and total salt content in saline alkali soil, improved soil fertility and enzyme activity, changed the composition and structure of microbial community in soil, and greatly improved the improvement effect of saline alkali soil [20].

4.4. Engineering improvement
The engineering improvement of saline alkali land is to build a flood drainage irrigation system, and use the water source in the system to wash the salt in the soil, so as to reduce the salt content in the original soil. Li Juan et al. Found in the research on the effect of different models on soil environmental improvement of saline alkali land that under different treatment models of traditional drainage and ecological water storage, ecological water storage treatment can effectively improve soil physical and chemical properties, improve soil stability and soil quality, and achieve good saline alkali land treatment [21]. Han Jichang and others have implemented a new management mode of "changing discharge to storage" in the saline alkali land of Shaanxi halo beach. The results show that under the new management mode of "changing discharge to storage", the pH value, salt content and salt ion content in the soil have been effectively reduced, the organic matter content has increased, the soil quality has been significantly improved, and the effect on the saline alkali land of halo beach has been significant [22]. Therefore, the treatment of saline alkali land first solves the problem of water, which can accelerate the movement of salt in water under the condition of unobstructed drainage, so drainage plays an important role in the process of improving soil salinization.

5. Conclusions
With the rapid development of social economy, land resources are over exploited, which makes the problem of soil salinization increasingly serious. Soil salinization has become one of the most important ecological problems in China and even in the world. For the existing problems of soil salinization, we should take multiple measures to carry out comprehensive management to prevent the recurrence of soil salinization. For our country, according to the different characteristics of saline alkali land, we should select reasonable improvement techniques and methods, optimize and control the salt content and soil nutrient status of saline alkali land, improve the soil quality of saline alkali land by Directional Cultivation, avoid the recurrence of secondary salinization, and realize the efficient utilization of saline soil resources in our country.

At present, there are many methods to improve saline alkali land, and more attention is paid to biological improvement measures. Phytoremediation technology is not only economical and effective, but also realizes the vegetation reconstruction and ecological restoration after the treatment of saline alkali land. Through a large number of studies on salt tolerant plants, salt tolerant varieties suitable for different regions were selected, which rapidly promoted the improvement process of saline alkali land, and has achieved significant economic and ecological benefits. Therefore, we should continue to strengthen the restoration of salt tolerant vegetation in the future, and strive to screen out more salt tolerant varieties.

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