Effects of Vegetation Construction on the Soil Environment in North China

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Abstract. Vegetation construction is one of the most important measures of ecology restoration in arid and semi-arid. Reasonable vegetation construction can improve the local soil environment and quality effectively. Thus, promote the vegetation restoration and ecology environment reconstruction. However, because of the different factors such as the plant trees, the ecology environment of vegetation construction in the vegetation construction, there are distinct influence on soil environment. This research choose the articles which related vegetation construction and soil environment in arid and semi-arid areas in China as the research object, in which we focus on the influence of soil moisture, soil organic mater and soil total nitrogen by artificial vegetation restoration.

1. Introduction

Arid and semi-arid regions exceed 40% of the global land area [1]. Due to the constraints of natural conditions and the constant pressure of human activities, the ecological environment in these areas is extremely fragile and it is prone to various types of ecological degradation including land degradation. In the context of expected climate change, the frequent occurrence of extreme weather events such as persistent drought increases the risk of desertification, which in turn leads to a further increase in the global desertification area [2, 3].

Ecological restoration and reconstruction is an important way to combat desertification in arid and semi-arid areas. Due to the limitations of natural environment and economic conditions, vegetation restoration measures vary from place to place. Vegetation construction is one of the most widely adopted measures for restoration and reconstruction. In the past more than half a century, in order to combat desertification and alleviate the ecological and environmental problems such as sandstorms, many countries have initiated large-scale vegetation construction projects, increased vegetation coverage, and reached the goal of ecological restoration and reconstruction to a certain extent, but It also brings a series of controversial ecological and environmental consequences. In particular, the
impact of artificial vegetation on the soil environment has received extensive attention. On the one hand, the planting of these artificial vegetation can enhance the water conservation function of the surface soil and significantly improve soil moisture, soil carbon, nitrogen and other soil environmental factors through the accumulation of litter on the surface [5-7] However, due to environmental factors such as tree species, soil texture, water conditions and climate background, the ecological results produced by vegetation construction models in different regions are not the same, and even serious water deficits and soil desiccation problems [7-9], causing afforestation activities not only have a beneficial impact on the ecological environment, but will exacerbate the deterioration of the ecological environment. Some studies suggest that vegetation construction has a positive contribution to soil ecosystem carbon stocks, but most of these increased carbon sequestrations exist in the form of highly biogas carbons, for relatively stable soil carbon pools. The contribution is very limited; some unreasonable methods of afforestation may even lead to a significant reduction in soil carbon content. Some studies also believe that some single species of artificial arbor forests have much lower carbon sequestration efficiency than naturally restored shrubs, so the artificial vegetation planted seems to be green, but the accumulation process of soil organic matter is very slow and even declines. Under the forest, the herbaceous plants are very rare, eventually forming a surface landscape called “green desert” [10, 11].

The arid and semi-arid regions of China are mainly distributed in the western part of the northeastern region, most of the Inner Mongolia Autonomous Region, the northern part of Hebei, Shanxi and Shaanxi provinces, the Ningxia Autonomous Region, the majority of Gansu Province, and Xinjiang, Tibet and other regions [12], accounting for the national total. Half of the area [13]. In this area, there are five major sand areas including Hulunbeier, Horqin, Hunshandak, Mu Us, Kubuqi and other areas, as well as the Taklimakan Desert, the Gurbantunggut Desert, the Badain Jaran Desert, and the Tengger Desert. Due to the harsh climatic conditions, the fragile ecological environment, and the strong interference of human unsuitable production and management activities, the ecological environment in arid and semi-arid regions of China has deteriorated severely, which not only endangers local industrial and agricultural production and people's lives, but also endangers the surrounding areas. Therefore, the study of vegetation construction in arid and semi-arid regions of China is of great significance not only for the ecological environment management and restoration in northern China, but also for the production and life of the people in the region. In recent years, some large-scale afforestation activities have played a detrimental effect on the deterioration of the ecological environment in northern China, resulting in a significant increase in soil water holding capacity in some areas, a gradual recovery of soil ecosystems, and complication and stabilization [14-16]. However, in addition to these achievements, there are still a lot of problems to be solved. Vegetation construction activities have caused serious imbalances in the water content of the forests in the area, and even the phenomenon of soil drying, a large amount of groundwater and other soil environmental resources are consumed, which leads to The consequences of reduced vegetation survival rate and preservation rate directly cause the ecological environment to deteriorate again and tend to be uncontrollable.

2. Research progress on the relationship between vegetation construction and soil environment at home and abroad

Vegetation construction is one of the most important links in ecological restoration and reconstruction [17]. Years of production practice has proved that bioengineering measures represented by returning farmland to forests, planting trees and planting grasses and restoring vegetation are effective measures to control soil erosion, improve the ecological environment, and control sandstorms [18]. Reasonable vegetation construction should not only take into account the current status of natural, social and economic development, but also must combine the characteristics of local natural habitats.
2.1. Advances in research on relationship between vegetation construction and soil moisture at home and abroad
Vegetation construction is one of the most commonly used measures to combat desertification and control sandstorms in arid and semi-arid regions of northern China. Because it is located in the hinterland of the mainland where precipitation is scarce, water is the most critical factor limiting vegetation construction in the region. It is particularly important to consider the vegetation-soil system water balance in the construction of vegetation [19]. Soil moisture is the only water that plants can directly use. Other sources of water (rainfall, groundwater, and surface water) must first be converted to soil water for use by plants. Different soil water patterns determine the spatial distribution and pattern of ecosystems [20]. At the same time, soil moisture status has an important impact on the long-term stable development of artificial sand-fixing vegetation [21]. In the arid and semi-arid areas with the most severe natural conditions, soil moisture has special physiological and ecological significance, which seriously affects the growth, structure and distribution characteristics of forest trees in the region. Vegetation is the most active and active factor affecting soil moisture [22]. Therefore, the study of existing vegetation and soil moisture status in this area is not only conducive to understanding the laws of the two, but also provides an important theoretical reference for the effective use of soil moisture and regional vegetation restoration [23].

In recent years, studies on soil water balance and dynamic changes in artificial vegetation areas in arid and semi-arid areas have shown that water consumption, vegetation construction types, vegetation establishment years, and differences in vegetation establishment areas will all affect the planting area. Soil moisture produces different effects and ecological consequences. On the one hand, vegetation construction has a positive effect on soil water conservation, soil and water conservation, etc. On the other hand, due to factors such as the large increase in water demand for artificial vegetation growth, soil desiccation occurs after vegetation construction in these areas [53]. At present, it is not uncommon to study the effects of vegetation construction on soil moisture in arid and semi-arid regions of China at home and abroad [24-26], but most of these studies are limited to small-scale research, lacking comprehensive analysis of similar studies; Due to the uncertainty and bias of individual research results [27, 28] and publication bias [29, 30], some research conclusions may appear inconsistent or contradictory phenomena [31].

2.2. Advances in research on relationship between vegetation construction and soil organic matter at home and abroad
Soil Organic Matter (SOM) is composed of a series of organic compounds that are present in the soil, have a heterogeneous composition and structure, and are mainly composed of carbon and nitrogen [32], which are important factors for characterizing soil quality. Soil organic matter is closely related to the supply of nutrients, the improvement of soil physical properties and the prevention of soil erosion [33]. Especially in arid desert areas, the soil organic matter content directly affects the soil quality in the region, and has a direct impact on the ecological evolution and environment of arid and semi-arid desertification areas. Therefore, studying the distribution and content of soil organic matter in this area is of great significance to the ecological restoration and reconstruction of the area. At present, the main measure to improve soil organic matter in arid and semi-arid areas is vegetation restoration. The mechanism is to make full use of the soil-plant complex system to improve soil function. Plant litter and roots and their microorganisms can provide new carbon sources to the soil. This increases the soil organic matter content [34]. However, the effect of vegetation planting on soil organic matter content is different under different conditions. Chang Qingrui [35] studied the effects of vegetation construction on soil organic matter content in Ganxian County, Shaanxi Province, and believed that vegetation construction in this area can significantly improve soil organic matter. Yan Lin et al. studied the changes of organic matter in soils in the vegetation construction area of Baotou City, indicating that the soil organic matter content increased year by year with the restoration of vegetation [36]. However, the soil organic matter content showed a significant decrease after the
sandcasting planted in Beijing sandy land [37]. The artificial forests in the hilly areas of the Loess Plateau in Ansai, Shaanxi Province also have significant effects on soil organic matter content [38].

2.3. Advances in research on relationship between vegetation construction and soil total nitrogen at home and abroad

Soil nutrient content and its dynamic balance are one of the important indicators reflecting soil quality, which directly affect soil fertility [39]. Therefore, soil nutrient elements have always been the focus of research at home and abroad. Nitrogen is a very important nutrient element. It is of great significance for vegetation growth, microbial activity and soil development. Improving its utilization efficiency or reducing its loss is one of the important strategies for plants to adapt to poor habitats. [40]. The arid and semi-arid regions of northern China are one of China's vegetation environment and its fragile areas. Due to human improper production activities and its own adverse ecological environment, soil quality in this area has been seriously degraded, and soil desertification has intensified. This trend has seriously affected the restoration and reconstruction of the local ecological environment. At present, the main measures for ecological restoration in arid and semi-arid areas are vegetation construction, and the vegetation-soil interaction will directly affect the dynamic balance of soil nutrient pools. On the one hand, plants will enrich and redistribute nutrients in the soil. The role of plant roots and litter will affect the content of soil elements; at the same time, soil nutrient elements will in turn affect the growth of vegetation [15]. Many studies have suggested that soil organic matter and soil total nitrogen are synchronously changing, but there are other cases [41]. Most studies suggest that vegetation restoration can improve soil nutrient elements [42-44], while research by Sheng Caiyu [45] indicates that vegetation restoration leads to a decrease in soil nutrient elements, especially in arid and semi-arid regions due to improper vegetation construction activities. As a result, the herb cover under the forest is reduced, soil erosion is intensified, and the soil quality is seriously reduced, which causes the soil nutrient elements to be seriously reduced. Therefore, the research and evaluation of soil total nitrogen status under vegetation construction can not only reflect the impact of vegetation restoration on soil nutrient elements, but also provide evaluation basis for vegetation restoration and ecological environment reconstruction in the region, and also have scientific knowledge for vegetation construction activities. Guiding significance.

3. Conclusion

Vegetation restoration is a major measure to improve the ecological environment. Reasonable artificial vegetation restoration can effectively improve the soil environment and play a role in soil and water conservation. However, in arid and semi-arid regions, artificial vegetation restoration is greatly limited due to water limitation. Different vegetation construction methods, as well as tree species, artificial vegetation density, water source, soil texture, climate background, topography, human activities and other factors will be it has an impact on the restoration of artificial vegetation. Therefore, in order to conduct a reasonable research and evaluation on the ecological consequences of vegetation construction, it is necessary to comprehensively consider all the above factors that can affect vegetation restoration.

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