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The Impact of Ecological Land Consolidation Projects on Soil Carbon Sequestration Capacity

Xiaowan Chen

Shaanxi Province Land Engineering Construction Group Science and Technology Entrepreneurship Bay Real Estate Co., Ltd, Xianyang, Shaanxi Province, 712000, China.

Abstract: Land consolidation is an important measure to expand the scale of arable land, improve the working environment of farmland, enhance agricultural productivity, and improve the production and living conditions of farmers. However, for a long time, land consolidation has remained at the stage of improving agricultural infrastructure. With the proposal of ecological and environmental protection concepts, ecological land consolidation projects are about to emerge. In the process of promoting this project, soil carbon sequestration capacity is one of the most important measures of ecological and environmental protection. Overview of the definition and connotation of soil organic carbon, and analysis of the impact of ecological land remediation projects on soil carbon sequestration capacity. On this basis, an overview of soil carbon sequestration measures in ecological land consolidation projects is provided, providing theoretical support and technical guidance for strengthening carbon sequestration work and enhancing soil carbon sequestration capacity in ecological land consolidation projects.

Keywords: Ecological carbon sequestration; Land consolidation; Technical points.

1. Introduction

In terrestrial ecosystems, soil organic carbon is an important carbon reservoir. According to statistical data, the soil organic carbon content is twice that of atmospheric carbon and three times that of plant carbon. Therefore, the carbon sequestration capacity of soil is not only related to soil fertility, but also to maintaining ecological balance: it is related to promoting the virtuous cycle of the entire farmland micro ecosystem. In recent years, land consolidation projects have gradually become a national strategic deployment. According to the requirements of the "General Principles for High Standard Farmland Construction", in the future, land consolidation should adhere to the concept of equal emphasis on quantity, quality, and ecology, and achieve multi standard development of farmland quantity, quality, landscape optimization, and good ecology. Therefore, the construction of ecological land consolidation projects is the mainstream trend in the land consolidation industry, and soil carbon sequestration capacity has become an important indicator for measuring the quality of ecological land consolidation project construction.

2. Definition and connotation of soil organic carbon

Soil organic carbon is a chemical indicator of soil organic matter, which is a balanced product formed by soil mineralization, decomposition, and synthesis processes. This includes animal and plant residues, humus, and other substances that are decomposing or are decomposing in the soil. In soil microecological systems, organic carbon provides important nutrient support for microbial growth, accelerates mineralization, promotes microbial respiration, and optimizes the environment for microbial growth. Soil organic carbon is beneficial for improving soil properties and enhancing soil function. By adjusting the organic carbon content, soil properties can be optimized and soil structure can be improved. In summary, organic carbon is an important criterion for evaluating soil quality, a crucial source of nutrients for crop growth, and a significant factor in comprehensively reflecting soil productivity. Therefore, organic carbon can be used to comprehensively reflect soil quality and health conditions.

3. The impact of ecological land consolidation projects on soil carbon sequestration capacity

3.1. The impact on soil organic carbon

Ecological land consolidation is the process of reorganizing, optimizing, and reusing land resources. The stability of organic carbon in the soil directly affects the stability of the soil and the growth of crops after consolidation. Meanwhile, research has confirmed that the organic carbon in surface soil serves as a coupling agent for the virtuous cycle of carbon elements in agricultural microecology, and is a barometer of external environmental changes, directly affecting the surrounding ecological environment.

From the perspective of the impact of land consolidation on organic carbon, by restructuring and adjusting soil components, the thickness of the cultivated layer will be greatly increased, the microbial content in the soil will be increased, the soil microecological balance will be improved, and the content of organic carbon in the soil will be increased. However, if the early planning is unreasonable, carbon sequestration measures are not in place, and the surface soil structure and texture are damaged, it will directly affect the changes in soil particles, exacerbate soil erosion, and affect the accumulation of organic carbon. Organic carbon is the core substance of soil fertility, and its content is related to soil structure, water and fertilizer retention, and affects soil productivity. In the process of ecological land consolidation, due to the involvement of multiple aspects, any omission in any link will affect the accumulation of organic carbon content and reduce the carbon fertility of the soil. In applied soils, the carbon sequestration function of soils with different uses exhibits differential changes. Among them, farmland soil

has the strongest carbon sequestration capacity, accounting for about 10% of all soil carbon storage. Therefore, through human intervention in farmland soil and short-term and large-scale carbon pool adjustment, it can improve soil yield, increase grain production, and mitigate greenhouse effect. However, farmland formed through human intervention in arid areas has experienced varying degrees of decline in soil carbon sequestration capacity. After being cultivated in desert areas, the soil carbon sink in farmland shows an increasing trend. Among them, the longer the reclamation time, the higher the proportion of organic carbon, organic matter, microorganisms and other substances will increase. Among them, the change in organic carbon is the largest and most sensitive to the impact on reclamation. The experiment of cultivating forest land into farmland resulted in a reduction of about 70% in the organic carbon content of the topsoil. In addition, in the process of cultivating farmland, the later agricultural management also has a significant impact on the changes in organic carbon in farmland.

3.2. Ihe impact on the active components of soil organic carbon

The activity of organic carbon is related to the vitality of soil microorganisms. Therefore, active components are an important driving force for soil microbial activity, playing an important role in improving soil quality, maintaining soil carbon balance, and other aspects. Active components are mainly composed of particulate organic carbon, soluble carbon, microbial biomass, and light organic carbon. Among these types of substances, heavy and light organic carbon is the most important measure of soil vitality. Granular organic carbon is an important indicator of soil organic carbon changes and accumulation. As a transitional substance for the transformation of organic matter from animal and plant residues and humus in soil, it plays a significant role in promoting the formation of soil aggregates and stabilizing the balance of carbon cycling. At the same time, particulate organic carbon is also responsible for the protection of carbon sequestration. In the process of land consolidation, the decrease in carbon sequestration capacity is mostly related to the loss of particulate organic carbon. There is research confirming that in the process of ecological land consolidation, different types of soil are reclaimed into farmland, and the first loss is also particulate organic carbon.

Nearly half of the soluble organic carbon in soil can be decomposed and utilized by microorganisms, which is the main source of energy for microbial activity in soil. Meanwhile, this component can also serve as a sensitive indicator of soil temperature and humidity changes. After wetland cultivation, the soluble organic carbon content in farmland will significantly decrease. In addition, soluble organic carbon also participates in the transformation, migration, and degradation of soil organic and inorganic matter, which is related to nutrient accumulation, pollutant transfer, and so on. Therefore, by reasonably applying soluble carbon, the goal of fertilizing soil can be achieved. In organic carbon components, microbial biomass carbon accounts for 1% to 4%, which is the sum of carbon content in small volume bacteria, fungi, animals and plants. The variability of microbial biomass carbon is greater than that of other active components. There is research showing that soil moisture content affects the growth period changes of microbial biomass carbon. In various types of applied soils, the microbial biomass and carbon content are significantly higher in riverbank and forest grassland soils compared to early soil. In addition, the activity of this component is also related to the quantity and quality of nutrients such as animal and plant residues, soil organic matter, nitrogen and phosphorus. Therefore, microbial biomass carbon can be used as a characterization of the degree of pollution, fertility, and other changes after soil remediation. Light organic carbon is one of the important components of active organic carbon. As a key substance for decomposing soil plant residues and litter, it has the characteristics of fast decomposition and turnover. In general, the turnover cycle of light organic carbon is between 5-15 years, and the increase in organic carbon in the 0-5 young group after reclaiming farmland from wasteland is over 90%. Research has shown that light organic carbon is most sensitive to land remediation, with the impact of surface soil light organic carbon being the most significant. In addition, the changes in this substance also exhibit seasonal fluctuations, which can serve as a response indicator for early soil organic carbon changes.

4. Soil carbon sequestration measures in ecological land consolidation projects

In general, after land consolidation, the soil has an imbalanced nutrient ratio structure, high soil capacity, poor overall soil structure, and disrupted land configuration. In response to such changes, it is necessary to focus on improving soil fertility quality by utilizing carbon sequestration measures such as advance planning before remediation, improving farmland fertilization techniques, and optimizing farmland cultivation techniques, in order to gradually optimize the newly formed soil configuration.

4.1. Advance planning before rectification

Before project implementation, it is necessary to develop a suitable land remediation plan in advance based on soil carbon sequestration requirements, in order to improve soil fertilizers, increase soil productivity, and reduce the impact of greenhouse effect. The implementation of excavation and filling projects strictly adheres to the principle of excavation and filling balance, tries to protect the original soil as much as possible, and accurately calculates the amount of excavation and filling soil. During the reconstruction and remediation process, the surface mature soil can be removed first. Afterwards, fill the soil according to the calculated excavation amount, remove the surface mature soil that will be removed, and pay attention to targeted application of organic fertilizer. In the process of soil remediation, it is necessary to provide a supporting irrigation system for farmland water conservancy to facilitate irrigation and ensure soil moisture. Constructing farmland protection forest projects to improve the farmland environment, optimize the farmland ecosystem, resist sandstorms, reduce soil erosion, and increase the content of soil organic nitrogen and carbon elements.

4.2. Improving Fertilization Techniques for Farmland

After land consolidation, it is necessary to improve fertilization techniques, gradually improve the soil, and gradually restore soil fertility. In general, the amount of fertilizer applied to newly constructed soil is higher than that applied to conventional soil. At the same time, achieve the

combination of nitrogen, phosphorus, potassium fertilizers, and organic fertilizers. The amount of nitrogen fertilizer should be flexibly adjusted according to the growth of seedlings in the field to adapt to the new changes brought about by soil nutrient adjustment. At the same time, it is necessary to apply peat and plant green manure to improve loose soil, increase air and water permeability, and promote soil particle formation. In addition, the microbial content in the newly improved soil is also lower than that in traditional farmland. Therefore, during the fertilization period, attention should be paid to increasing the application of bio fertilizers to balance the number of microbial communities in the soil, improve soil fertility, and enhance nutrient utilization efficiency.

4.3. Optimize farmland cultivation techniques

RIt is inevitable that the soil fertility will be low after land consolidation, and directly cultivating and planting crops is very detrimental to crop growth. In order to coordinate the quantity and quality of soil remediation and continuously enhance soil carbon sequestration capacity, it is necessary to improve and fertilize the soil in a targeted manner to improve soil fertility. Pay attention to adjusting crop layout and rotating crops reasonably while fertilizing the soil. Pay attention to improving agricultural techniques, combining deep plowing, deep plowing, planting green manure and other measures during the suitable soil cultivation period to improve the soil tillage layer, enhance the soil's water storage and moisture retention capacity, promote soil maturation, and create a good farmland environment for crop growth. Pay attention to improving sowing techniques, promoting no till sowing techniques, reducing wind and water erosion of the soil, controlling the cost of farmland cultivation, protecting the ecological environment of farmland, and promoting the healthy and sustainable development of agriculture.

5. Conclusion

Soil organic carbon is one of the most important carbon pools in terrestrial ecosystems and the most important measure of soil carbon sequestration capacity in ecological land remediation projects. From the perspective of ecological land consolidation projects, by restructuring and adjusting soil components, the thickness of the cultivated layer will be greatly increased, the microbial content in the soil will be increased, the soil microecological balance will be improved, and the content of organic carbon in the soil will be increased. However, if the early planning is unreasonable, carbon sequestration measures are not in place, and the structure and texture of the topsoil are damaged, it will directly affect soil particle changes, exacerbate soil erosion, and affect the accumulation of organic carbon. In response to such changes, it is necessary to focus on improving soil fertility quality by utilizing carbon sequestration measures such as advance planning before remediation, improving farmland fertilization techniques, and optimizing farmland cultivation techniques, in order to gradually optimize the newly formed soil configuration and increase soil output levels.

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