

# Research on the Path of Improving Farmland Quality based on Carbon Neutrality Background

Jinyang Zhang<sup>1,2,3,4,5,6,\*</sup>, Jing Zhang<sup>1,2,3,4,5,6</sup>, Na Lei<sup>1,2,3,4,5,6</sup>

<sup>1</sup> Shaanxi Agricultural Development Group Co., Ltd., China

<sup>2</sup> Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., China

<sup>3</sup> Key Laboratory of Degraded and Unused Land Consolidation Engineering, Ministry of Natural Resources, China

<sup>4</sup> Shaanxi Engineering Research Center of Land Consolidation, China

<sup>5</sup> Land Engineering Technology Innovation Center, Ministry of Natural Resources, China

<sup>6</sup> Key Laboratory of Cultivated Land Quality Monitoring and Conservation, Ministry of Agriculture and Rural Affairs, China

## Abstract

This study explores the path to improving farmland quality under the background of carbon neutrality. Through literature analysis and case studies, the concept and relationship between carbon neutrality and cultivated land quality were elaborated, and the current situation and existing problems of cultivated land quality in China were analyzed. Research has found that improving the quality of arable land is of great significance for achieving carbon neutrality goals. Based on this, paths for improving the quality of cultivated land have been proposed, including optimizing the farming system, promoting conservation tillage techniques, strengthening soil improvement and fertilization, and developing ecological agriculture. At the same time, safeguard measures for implementing these paths were explored from the aspects of policy support, technological innovation, and farmer participation. The research results can provide theoretical basis and practical guidance for promoting green agricultural development and achieving carbon neutrality goals.

## Keywords

Carbon Neutrality; Quality of Cultivated Land; Improvement Path; Conservation Tillage; Ecological Agriculture; Soil Improvement.

## 1. Introduction

With the increasingly severe global climate change problem, carbon neutrality has become a common goal of the international community. As the world's largest developing country, China proposed the strategic goal of "peaking carbon emissions before 2030 and achieving carbon neutrality before 2060" in 2020. Agriculture, as one of the important sources of greenhouse gas emissions, plays a crucial role in achieving carbon neutrality goals. As the foundation of agricultural production, the quality of arable land directly affects the sustainability and carbon emissions level of agricultural production. In recent years, the overall quality of arable land in China has shown a downward trend, and problems such as soil degradation and declining fertility have become increasingly prominent, seriously restricting the sustainable development of agriculture. In this context, exploring the path of improving farmland quality based on carbon neutrality background is of great significance. This study aims to analyze the

relationship between carbon neutrality and farmland quality, explore effective paths to improve farmland quality, and provide theoretical support and practical guidance for achieving agricultural green development and carbon neutrality goals.

## 2. Overview of Carbon Neutrality and Farmland Quality

Carbon neutrality refers to achieving a balance between anthropogenic carbon dioxide emissions and absorbed carbon dioxide by reducing greenhouse gas emissions and increasing carbon sinks. [1] This concept originates from international efforts to address climate change, aiming to slow down the trend of global warming by controlling greenhouse gas emissions. In the field of agriculture, carbon neutrality is mainly achieved through reducing carbon emissions from agricultural activities and increasing soil carbon sinks. The quality of arable land refers to the ability of arable land to meet the needs of crop growth and agricultural production, including multiple aspects such as soil fertility, structure, and biological activity. High quality arable land not only improves crop yield and quality, but also enhances soil carbon sequestration capacity, playing an important role in achieving carbon neutrality goals. There is a close interaction between the quality of arable land and carbon neutrality: on the one hand, high-quality arable land can fix more carbon and reduce greenhouse gas emissions; On the other hand, achieving carbon neutrality goals requires the improvement of arable land quality as the foundation.

## 3. Analysis of the Current Situation and Problems of Farmland Quality in China

In recent years, the overall quality of arable land in China has shown a downward trend. According to the "National Farmland Quality Grade Bulletin" released by the Ministry of Agriculture and Rural Affairs, the average grade of arable land quality in China is 4.76, with over 70% of it being medium and low yield fields. The main problems include a decrease in soil organic matter content, soil compaction, acidification, salinization, etc. These issues not only affect agricultural production efficiency, but also weaken the carbon sequestration capacity of arable land. The reasons for the decline in arable land quality are multifaceted. Firstly, the long-term overuse of chemical inputs such as fertilizers and pesticides has led to soil ecological imbalance. Secondly, unreasonable farming and land use practices exacerbate soil degradation. Furthermore, industrial pollution and urban expansion have also had a negative impact on the quality of arable land. In addition, the increase in extreme weather events brought about by climate change also poses new challenges to the quality of arable land [2].

## 4. Path to Improving Farmland Quality Based on Carbon Neutrality Background

In the context of carbon neutrality, comprehensive measures need to be taken to improve the quality of arable land. Firstly, optimizing the farming system is crucial. By promoting the crop rotation fallow system, soil structure can be effectively improved and soil fertility can be enhanced. For example, promoting corn soybean rotation in Northeast China can not only increase crop yields, but also increase soil organic matter content and enhance carbon sequestration capacity. Secondly, promoting conservation tillage techniques is an important approach. Conservation tillage techniques such as no till and reduced tillage can reduce soil disturbance, lower carbon emissions, and increase soil organic matter content. [3] For example, the promotion of wheat maize double cropping conservation tillage in the North China Plain can not only maintain soil moisture, but also reduce carbon emissions from mechanical operations. Strengthening soil improvement and fertilization is the foundation for improving

the quality of arable land. By increasing the application of organic fertilizers and planting green manure, the soil organic matter content can be increased and the soil structure can be improved. For example, promoting straw returning and green manure planting in southern rice growing areas can not only improve soil fertility but also increase soil carbon sequestration. Developing ecological agriculture is an effective way to achieve the goals of improving farmland quality and carbon neutrality. By promoting models such as organic agriculture and circular agriculture, the use of chemical inputs can be reduced and agricultural carbon emissions can be lowered. For example, promoting forest agriculture integrated systems in southwestern mountainous areas can not only improve land use efficiency, but also enhance the carbon sequestration capacity of ecosystems.

## 5. Implementation Guarantee for Improving the Quality of Arable Land

To ensure the effective implementation of the path to improving the quality of arable land, multiple safeguard measures are needed. Firstly, policy support and institutional innovation are key[4]. The government should formulate and improve relevant laws and regulations to provide legal protection for the quality of cultivated land. At the same time, establish a sound monitoring system for farmland quality to provide a basis for scientific decision-making. In addition, we should innovate the compensation mechanism for farmland protection and encourage farmers to participate in improving the quality of farmland. Secondly, technological innovation and promotion are important supports. We should increase investment in agricultural technology research and development, and develop technologies to improve farmland quality that are suitable for carbon neutrality goals. Strengthen the construction of the agricultural technology promotion system and improve the technology delivery rate. For example, developing intelligent soil monitoring and fertilization systems to achieve precision agricultural management. Farmers' participation and capacity building are the foundation for improving the quality of arable land. Farmers' training should be strengthened to enhance their awareness and skills in protecting farmland. By establishing organizational forms such as farmer cooperatives, we can enhance the level of organization and bargaining power of farmers. At the same time, encourage farmers to participate in monitoring and protecting the quality of arable land, and create a good atmosphere for the whole society to participate together[5].

## 6. Conclusion

This study explores the path to improving farmland quality based on the background of carbon neutrality. Research has shown that improving the quality of arable land is of great significance for achieving carbon neutrality goals. By optimizing the cultivation system, promoting conservation tillage techniques, strengthening soil improvement and fertilization, and developing ecological agriculture, the quality of arable land can be effectively improved and the carbon sequestration capacity of agriculture can be enhanced. Meanwhile, policy support, technological innovation, and farmer participation are important guarantees for implementing these paths. In the future, research on the relationship between carbon neutrality and farmland quality should be further strengthened, and more precise and efficient technologies for improving farmland quality should be explored. At the same time, attention should be paid to the characteristics of different regions and differentiated strategies for improving the quality of arable land should be formulated. Only through multi-party collaboration and comprehensive policies can we achieve the coordinated development of improving farmland quality and achieving carbon neutrality goals, and promote the green transformation and sustainable development of agriculture.

## Acknowledgments

This work was financially supported by the Key Research and Development Program of Shaanxi, China (Program No.2022ZDLNY02-01 and 2023-ZDLNY-52), Xi'an Science and Technology Plan Project, China (22NYGG0001).

## References

- [1] Zhang Mingyuan, Li Hongmei Research on the Green Development Path of Agriculture under the Background of Carbon Neutrality [J]. Agricultural Economic Issues, 2022, 43(5): 23-35.
- [2] Wang Lixin, Chen Siyuan Exploration of the Collaborative Mechanism between Improving Farmland Quality and Enhancing Carbon Sequestration Capacity [J]. Chinese Agricultural Science, 2023, 56(2): 78-90.
- [3] Liu Changqing, Zhao Xiaohui Research progress on the impact of conservation tillage techniques on soil carbon sinks [J]. Journal of Soil Science, 2021, 58(4): 1123-1135.
- [4] Sun Wenbin, Zhou Liqun Application and Prospect of Ecological Agriculture Model in Improving Farmland Quality [J]. Journal of Ecology, 2022, 42(15): 5678-5690.
- [5] Zheng Yawen, Huang Zhiqiang Research on Agricultural Policy Innovation under Carbon Neutrality Target [J]. Research on Agricultural Modernization, 2023, 44(1): 45-58.