

Research on the Development of Low-carbon Agriculture in Anhui Province under the Carbon Peaking and Carbon Neutrality Goals

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Abstract

Global warming has become a widespread concern of the international community. In all aspects of human life, the biggest impact on global warming is the carbon emissions from agriculture, which account for one-third of the total greenhouse gas emissions. Therefore, the development of low-carbon economy and low-carbon agriculture is an inevitable trend. Based on the Carbon Peaking and Carbon Neutrality Goals, in order to promote the development of low-carbon agriculture in Anhui Province, this article summarizes the current situation of low-carbon agriculture development in Anhui Province, analyzes the difficulties faced by the development of low-carbon agriculture in Anhui Province, namely insufficient input of knowledge-based labor force, continuous increase in agricultural production costs, and structural contradictions. It is recommended to enhance the low-carbon concept of farmers, improve the efficiency of resource utilization, realize agricultural product branding, and leverage the role of cooperatives, so as to promote the sustainable development of agriculture in Anhui Province and help China achieve the peaking and carbon neutrality goals as soon as possible.

Keywords

Low-carbon Agriculture; Carbon Peaking and Carbon Neutrality Goals; Anhui Province.

1. Introduction

In the context of continuous global warming, China, as a major carbon emitter, plays an important role in achieving global emission reduction goals. In 2020, China proposed that the carbon emissions per unit of domestic GDP in 2030 will be reduced by more than 65% compared with 2005, and the carbon dioxide emissions will strive to reach the peak by 2030, and strive to achieve the goal of carbon neutrality by 2060, which strongly demonstrates China's image as a responsible and responsible big country. To achieve this emission reduction commitment, all industrial sectors, including agriculture, should contribute to greenhouse gas emissions reduction. The carbon emissions of the agricultural sector account for 17% of the total carbon emissions, making it a huge carrier of carbon emissions. It is particularly important to consider the development of low-carbon agriculture as an important lever for carbon reduction. On the one hand, the agricultural sector has enormous potential for carbon reduction. Compared with the United States, which is also a major agricultural country in the world, there is no significant difference in total carbon emissions between China and the United States. However, the carbon emissions from agriculture in the United States only account for 6.3% of its total carbon emissions, far lower than the level of 16% -17% in China, indicating that there is significant room for carbon reduction in China's agricultural sector; On the other hand, agricultural carbon reduction has a significant positive external effect. Agricultural carbon emission reduction not only reflects the efficient use of agricultural materials such as chemical

fertilizers and pesticides, but also means the widespread use of agricultural low-carbon technologies such as straw returning, which is conducive to improving soil nutrition, improving soil structure and improving the quality of agricultural environment, and has positive significance for promoting sustainable agricultural development.

Rich research results have been formed both domestically and internationally regarding the development of low-carbon agriculture. Heng Zheng (2014) believes that China should first formulate a relatively complete strategy when developing low-carbon agriculture models, and further promote the development of low-carbon agriculture through technological innovation. Leigang Shi (2011) concluded that large-scale planting can effectively promote the development of low-carbon agriculture by analyzing the planting patterns of wheat and summer maize in the North China Plain. Cooper and Rosin (2014), after studying the development of low-carbon agriculture in New Zealand, believe that in order to better reduce agricultural carbon emissions, it is not only necessary for the government to implement mandatory measures, but also to fundamentally enhance farmers' low-carbon awareness. Based on research on carbon emissions from agriculture in Spain, Chang (2016) believes that carbon intensity has a strong negative inhibitory effect on local agricultural carbon emissions. It can be seen that the current theoretical research system on low-carbon agriculture has become increasingly rich and is developing towards diversification. However, the process of low-carbon agriculture in China is still not smooth, and the theoretical system of low-carbon agriculture is not yet perfect. Many suggestions lack pertinence, and in-depth research has not been conducted based on local actual situations. On the basis of existing research results, this article takes low-carbon agriculture in Anhui Province as the research object, which has profound significance in promoting the sustainable development of agriculture in Anhui Province and fully playing the important role of Anhui in ensuring food security in China.

2. Current Situation of Agricultural Development in Anhui Province

2.1. Agricultural Production

Anhui is a major agricultural province. In 2021, the permanent population of Anhui Province was 61.13 million, with an urban population proportion of 59.39%. Among them, Hefei has a relatively high level of urbanization development, reaching 84.04%. The urbanization level in northern Anhui is the lowest at 42.74%, while the urbanization rate in southern Anhui is the highest at 72.99%. In terms of economy, Anhui Province has continuously improved its agricultural development mode, and the level of agricultural economy has steadily increased. In 2021, the total agricultural output value of Anhui Province reached 28029 billion yuan, accounting for 6.52% of the province's GDP. The total annual grain output reached 40.876 million tons, ranking fourth in the country. From the perspective of the proportion of agriculture in regional production, the importance of agriculture in Anhui's economic development is relatively high. In addition, Anhui's agriculture is dominated by traditional agricultural production methods, so the carbon emissions generated by agriculture every year cannot be ignored.

2.2. Low Carbon Agriculture

Although Anhui plays an important role in national grain production, compared with major agricultural provinces such as Heilongjiang and Sichuan, Anhui's agricultural production shows a high dependence on the total power of agricultural machinery and the use of fertilizers. The so-called total power of agricultural machinery refers to the machinery and equipment used for activities such as planting, animal husbandry, initial processing of agricultural products, agricultural transportation, and basic construction of farmland. The power used includes diesel engines, gasoline engines, electric motors, and other mechanical power (such as water power,

wind power, coal, solar energy, etc.). In 2021, the total power of agricultural machinery in Anhui Province reached 69.2432 million kilowatts, accounting for 6.43% of the total power of machinery in China. However, the proportion in Heilongjiang Province and Sichuan Province is only 6.41% and 4.49%, respectively. As an important indicator reflecting the construction of farmland water conservancy, the effective irrigation area includes the sum of the area of paddy fields and irrigated land that can be irrigated normally. In 2020, the effective irrigation area in Anhui Province was 4.609 million hectares, accounting for 6.66% of the national effective irrigation area. This proportion is higher than 4.33% in Sichuan Province, but lower than 8.92% in Heilongjiang Province. In addition, Anhui's agricultural production is highly dependent on fertilizers. If we look at the actual amount of agricultural fertilizers used in agricultural production in 2020, including nitrogen fertilizer, phosphorus fertilizer, potassium fertilizer, and compound fertilizer, the amount of fertilizer application in Anhui Province reached 2.847 million tons, accounting for 5.42% of the national fertilizer application, both higher than Heilongjiang (4.55%) and Sichuan (3.94%). The use of fertilizers in crop production has exacerbated greenhouse gas emissions from agriculture and increased the carbon density of land.

2.3. Brief Summary

From the above analysis, it can be seen that as a major agricultural province, there is a certain gap between the current agricultural development mode and the low-carbon economic development mode in Anhui, and the development of low-carbon agriculture is relatively backward. With global climate change and the increasing demand for low-carbon economy from global economic development, the development of low-carbon agriculture has become an inevitable trend in global agriculture and China's agricultural development. Based on the important position of agriculture in the national economy of Anhui Province and the relative importance of Anhui agriculture in the national agricultural production pattern, it is undoubtedly a serious challenge for Anhui Province to transform its agriculture from a high carbon agriculture that relies heavily on agricultural machinery and fertilizers to an environmentally friendly low-carbon agriculture.

3. The Difficulties Faced by the Development of Low Carbon Agriculture in Anhui Province

3.1. Insufficient Investment in Knowledge-based Labor Force

Due to the low quality, older age, and low labor efficiency of agricultural labor in Anhui Province, the inability to control new agricultural machinery and the lack of skilled workers, the new generation of farmers rarely participate in specific agricultural activities. Although the grain yield is high, the quality of grain is uneven, and substandard grain cannot be smoothly digested by the market. In order to effectively ensure the income of farmers and avoid their losses, the government can only take intervention measures to deal with it. The grain stored in the market has led to a consistently high inventory of grain. From 2015 to the end of 2019, Anhui Province launched nearly twenty minimum purchase price execution plans and implemented temporary storage acquisition policies multiple times. Through targeted intervention policies, it was found that although the quantity of some grain output in Anhui Province has improved, there is a deviation between the quality and consumer demand. Especially in recent years, resource destruction has been severe and the environment has been harsh, which is not conducive to the growth and harvest of crops. In some areas along the Huaihe River in our province, which are the main wheat producing areas, there have been frequent occurrences of wheat scab and incomplete grain exceeding standards in recent years.

3.2. Market Failure of Agricultural Products and Continuous Rise of Production Costs

Marshall's free market theory suggests that the market is only effective when factors are reasonably allocated. From the perspective of the price of agricultural products in China, the lowest purchase price currently implemented still belongs to the government pricing. The government's intervention has led to the formation of distorted Price signal in the market, and the rational allocation of resources in the effective market and the regulatory role of price leverage cannot be played. The substandard quality of grain and the government's support for market protection have led to a widening gap in domestic and international grain prices. Domestic grain prices are generally higher than those of foreign countries, and the phenomenon of inverted prices of agricultural products at home and abroad is becoming increasingly severe. Taking 2018 as an example, by comparing the minimum purchase price in the domestic market with the current price in the international market, the higher prices are wheat 5%, rice 3%, and corn 4%, respectively. This price inversion phenomenon has squeezed the price increase space of domestic agricultural products. Although the minimum purchase price objectively protects the interests of farmers, China's grain production has clearly lost its competitive advantage in the international market.

3.3. Structural Contradictions are Prominent, and Imports are Increasing Year by Year

Due to the quality of agricultural products in our country not meeting market requirements, although domestic grain production has achieved a "16 consecutive increases" and inventory is also very sufficient. However, China's annual grain imports remain consistently high. The strange circle of high production, high inventory, and high imports is highlighted. Only by adjusting the structure of China's planting industry can we solve the structural contradictions that arise on the supply side and achieve the rational allocation of resources. From the actual situation in our province, to adjust the agricultural structure, the first consideration is the land endowment, based on the regional division of the Huai River and the Yangtze River, and combined with the geomorphic characteristics, to make a reasonable layout. For a long time, the development of petroleum agriculture has focused on the growth of quantity. Over irrigation and abuse of chemical fertilizers and pesticides have led to the decline of soil fertility and serious consumption of groundwater resources. Although the output has improved, the quality does not meet the standards, which has seriously affected the sustainable development of modern agriculture in our province.

4. Suggestions for Promoting the Development of Low Carbon Agriculture in Anhui Province

4.1. Enhance the Low-carbon Concept of Farmers and Enhance the Professional Quality of Labor Force

Anhui Province has a large population, high mobility, and a large agricultural scale. Many farmers do not have the concept of low-carbon agriculture. Therefore, on the one hand, the government should increase the promotion of low-carbon agriculture, fully utilize media such as newspapers to popularize relevant knowledge to the public, and at the same time, it is necessary to deeply promote the government's preferential policies related to low-carbon agriculture. On the other hand, we must improve the quality of farmers. Farmers are the main body of agricultural production activities, and improving their utilization of low-carbon technologies can better promote the development of low-carbon agriculture in Anhui Province. Especially in the northern Anhui region, where the rural population is the highest and there is a large amount of agricultural labor force, it is necessary to attach importance to basic

education in rural areas, increase the management of rural education, balance the distribution of education resources between urban and rural areas, and fundamentally improve the scientific and cultural literacy of farmers. Secondly, the government should actively introduce corresponding high-quality talents, formulate a talent introduction plan, and expand the low-carbon technology personnel team. We can cooperate with surrounding universities and agricultural departments to periodically arrange technical personnel to guide farmers in low-carbon agricultural production in the countryside, provide free training opportunities for farmers, carry out multi-dimensional publicity and education in rural areas, actively cultivate farmers to use high-tech in agricultural production, and truly involve farmers in the process of building green mountains and rivers.

4.2. Improve Resource Utilization Efficiency and Upgrade Low-carbon Technologies

The research and use of low-carbon agricultural technology is the core of low-carbon agricultural production, determining the development direction and process of low-carbon agriculture. The promotion of low-carbon technology is a prerequisite for reducing agricultural carbon emissions, and also a key to improving the utilization rate of agricultural resources. In terms of research and development, Anhui Province needs to increase its efforts to research and support low-carbon technologies. The government should introduce relevant preferential and incentive policies, establish special funds to encourage and support the research and development of low-carbon technologies, actively cooperate with various universities, and promote the integrated development of industry, academia, and research. At the same time, actively engage in low-carbon technology exchange and learning with both domestic and foreign countries, absorb advanced technologies, and promote the smooth development of new technologies. In the promotion stage, the government, as the main body, should provide corresponding guarantee measures for enterprises and individuals using low-carbon technologies to enhance their market competitiveness. At the same time, new media will be used to promote low-carbon technologies, actively organize training sessions, comprehensively enhance public awareness of low-carbon issues, and promote the transformation of technological achievements into economic benefits.

4.3. Realize Branding of Agricultural Products based on Factor Endowments

Anhui Province has a superior geographical location, abundant agricultural elements, and natural resources suitable for the growth of various crops. The land types in Anhui Province are 25.5% in plain areas, 29.5% in hills, 31.2% in mountainous areas, 5.8% in polder areas, and 8.0% in lake depressions. The rich terrain facilitates the production and growth of various crops. The lowest index of multiple cropping of cultivated land in the province is 180%, and it is suitable for three seasons in some areas, with a multiple cropping index of up to 230%. Anhui Province actively develops crop diversification, broadens sales channels, uses network marketing, focuses on developing branding, and takes the path of green agriculture. The "Baihu" brand rice of Baihu Farm Group has formed four major series, including "Ecological White Lake", "Fragrant Land", "Green Field", and "Small Apple", with over 20 product varieties. Represented by "Organic Rice", "Selenium Rich Rice", "Fragrant Soft Rice", and "Functional Brown Rice", it has established an organic rice planting base and strictly organized production in accordance with national organic food production standards. All 31 indicators meet organic food standards, the natural "independent water source, complete isolation, one season planting, and winter green manure" have laid the foundation for the development of ecological agriculture in Anhui Province. In terms of sales, an intensive marketing network has been established.

4.4. Play the Role of Cooperatives and Explore the Integration and Development of Agricultural Industries

Cooperatives have played a significant role in guiding production, establishing brands, and providing income security for their members. However, the improvement of total factor productivity through supply side reform requires multiple approaches. Continue to play the role of cooperatives, through technical guidance and more advanced methods for specialized production. As of the end of 2020, Anhui Province has cultivated over 100000 family farms, 80000 professional farmer cooperatives of various types, developed 3000 modern agricultural industrialization consortiums, and more than 50 agricultural product processing enterprises, with agricultural business income exceeding 2 billion yuan; By innovating production and extending the production process under the supply chain, we can promote the multi-dimensional integration of agriculture with other industries and forms. The development of cooperatives in Anhui Province has achieved initial results. The cooperative has registered its own trademark and established a website. In terms of organizational production, cooperatives have increased investment in green production and the integration of the Internet of Things. They actively explore organic vegetable cultivation, physical methods, and ecological environment regulation in green production, and sell through the cooperative's website platform. At the same time, various regions in our province are exploring ideas for the integration and development of agricultural industries. Tianhe Agricultural Technology Co., Ltd. has pioneered a full range of farming services for farmers, including "farming, seedling raising, transplanting, harvesting, and field management", abbreviated as "one management". It attempts to integrate agriculture and service-oriented industries, and implements and promotes the "seed to seedling, seedling into rural areas" project nationwide. During the production process, strict standards and normative processes for seedling production have been established. At present, Tianhe Company has established more than 80 cooperatives in the province, helping farmers in more than 40 major rice counties in our province to develop planting plans, provide mechanized services and financial support, establish agricultural product purchase and sales networks, and achieve standardized management across the entire agricultural product industry chain.

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References

- [1] H. Zheng, Y. Li: Analysis on the Development Model of Low Carbon Agriculture, Issues in Agricultural Economy, Vol. 32 (2014) No.6, p.26-29.
- [2] L.G. Shi, F. C and F.L. Kong: Study on Carbon Footprint of Winter Wheat Summer Maize Planting Model in North China Plain, China Population, Resources and Environment, Vol. 21 (2011) No.9, p.93-98.
- [3] M.H. Cooper, C. Rosin: Absolving the Sins of Emission: The Politics of Regulating Agricultural Greenhouse Gas Emissions in New Zealand, Journal of Rural Studies, Vol. 36 (2014) No.6, p.391-400.
- [4] N. Chang, M.L. Lahr: Changes in China's Production-source CO₂ Emissions: Insights from Structural Decomposition Analysis and Linkage Analysis, Economic Systems Research, Vol. 24 (2016) No.2, p.224-242.
- [5] E. Dace, D. Blumberga: How do 28 European Union Member States perform in agri-cultural greenhouse gas emissions? It depends on what we look at:Application oft-he multi-criteria analysis[J]. Ecological Indicators, 2016, 71:352-358.

- [6] S.C. Xu, L. Zhang and Y.T. Liu: Determination of the factors that influence increments in CO₂ emissions in Jiangsu, China using the SDA method, Journal of Cleaner Production, Vol. 15(2017) No.1, P.187-201.