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LITERATURE REVIEW ON THE TRANSFORMATION OF AGRICULTURAL ECONOMIC DEVELOPMENT MODE UNDER THE BACKGROUND OF LOW–CARBON ECONOMY IN CHINA

ЛИТЕРАТУРНЫЙ ОБЗОР ТРАНСФОРМАЦИИ МОДЕЛИ ЭКОНОМИЧЕСКОГО РАЗВИТИЯ СЕЛЬСКОГО ХОЗЯЙСТВА В КОНТЕКСТЕ НИЗКОУГЛЕРОДНОЙ ЭКОНОМИКИ В КИТАЕ

Abstract. Currently, the concept of a low–carbon economy is becoming increasingly relevant, defining new development vectors. Under the influence of the principles of a low–carbohydrate approach, traditional farming models are evolving towards sustainable practices. The main objective of this work is to study the specific features of the agricultural sector in the context of a modern low–carbon economy. The aim is to identify the key challenges facing low–carbon agriculture and propose promising strategies for its development.

Keywords: low–carbon agriculture, agricultural development, ecology, carbon emissions reduction, animal husbandry, ecological agriculture, policy support system, recycling technologies.

Аннотация. В настоящее время концепция низкоуглеродной экономики приобретает все большую актуальность, определяя новые векторы развития. Под воздействием принципов низкоуглеродного подхода, традиционные модели ведения сельского хозяйства эволюционируют в сторону устойчивых практик. Основная задача данной работы заключается в исследовании специфических черт аграрного сектора в контексте современной низкоуглеродной экономики. Цель состоит в том, чтобы выявить ключевые вызовы, стоящие перед низкоуглеродным сельским хозяйством, и предложить перспективные стратегии его развития.

Ключевые слова: низкоуглеродистое сельское хозяйство, развитие сельского хозяйства, экология, сокращение выбросов углекислого газа, животноводство, экологическое сельское хозяйство, система поддержки политики, технологии переработки отходов.

As the global climate change problem becomes increasingly serious, low–carbon economy has gradually become an important trend in global economic development. Agriculture, as a basic industry of the national economy, plays a key

role in the low–carbon transformation. In recent years, many scholars have conducted extensive and in–depth research on the transformation of agricultural economic development mode under the background of low–carbon economy. This paper aims to review the relevant literature in order to provide a reference for further research in this field.

1. The significance of low–carbon agricultural development

The development of low–carbon agriculture is of great significance for addressing climate change and achieving sustainable agricultural development. On the one hand, agriculture is one of the important sources of greenhouse gas emissions. By developing low–carbon agriculture, carbon emissions in the agricultural production process can be effectively reduced, alleviating the pressure of climate change. For example, Zheng Xueming (2024) pointed out that greenhouse gas emissions from global agricultural production account for about 14% of the global total emissions, of which methane and nitrous oxide account for 50% and 35% of agricultural emissions respectively. The implementation of low–carbon agriculture can reduce greenhouse gas emissions and improve the ability of agriculture to adapt to climate change [1]. On the other hand, low–carbon agriculture emphasizes the efficient use of resources and the protection of the ecological environment, which helps to improve the stability and sustainability of agricultural production and ensure food security. Wang Haixia (2023) believes that the development of a low–carbon agricultural economy can reduce greenhouse gas emissions, improve air quality, protect soil and water resources, and at the same time improve the quality and safety standards of agricultural products and enhance the market competitiveness of agricultural products [3].

2. Challenges faced by low–carbon agricultural development

Although the development of low–carbon agriculture is of great significance, it still faces many challenges in its actual implementation.

1. Agricultural production methods and resource utilization efficiency

Traditional agricultural production methods have problems with high carbon emissions and low resource utilization efficiency. Excessive application of fertilizers and pesticides not only leads to a decline in soil quality, but also increases greenhouse gas emissions. For example, the greenhouse effect of nitrous oxide is 300 times that of carbon dioxide (Zheng Xueming, 2024) [1] . Although the increase in the degree of agricultural mechanization has improved production efficiency, it has also led to an increase in fossil fuel consumption, resulting in an increase in carbon dioxide emissions. In addition, agricultural resource utilization efficiency is low, water resource utilization efficiency is not high, land resource utilization efficiency is insufficient, fertilizer utilization rate is low, agricultural machinery utilization efficiency is not high, and biomass resources such as crop straw are not fully utilized (Zheng Xueming, 2024; Wang Yinghui, 2024) [1], [4] . These problems not only reduce agricultural production efficiency and increase production costs, but also indirectly lead to more carbon emissions, which is inconsistent with the requirements of low–carbon economic development.

2. Agricultural industrial structure and ecological environment issues

The irrational agricultural industrial structure has restricted the low–carbon

development of the agricultural economy. The planting industry has a single structure, the animal husbandry industry is unbalanced, the fishery structure has problems, the agricultural product processing industry is lagging behind, and the agricultural service industry is underdeveloped (Zheng Xueming, 2024) [1] . These problems not only limit the overall benefits of agriculture, but also are not conducive to the efficient use of resources and the reduction of carbon emissions. In addition, the deterioration of the agricultural ecological environment has also become a serious challenge facing the development of low–carbon agriculture. Problems such as soil degradation, water resource pollution, and a sharp decline in biodiversity not only directly affect the sustainability of agricultural production, but also indirectly increase the carbon footprint of agriculture (Zheng Xueming, 2024; Li Lingyue, 2024) [1],[6] .

3. Technical and Awareness Issues

The promotion and application of low–carbon agricultural technologies are affected by factors such as farmers' innovative skills, policy environment, and market demand. On the one hand, the initial application of some low–carbon agricultural technologies requires high investment, and the research and development of some key technologies in greenhouse gas emission reduction has not yet fully matured (Zhang Delong, 2024) [7]. On the other hand, farmers do not have a deep understanding of low–carbon agricultural technologies and lack sufficient theoretical knowledge and skills to design complex agricultural ecosystems (Li Lingyue, 2024) [6] . In addition, farmers' weak low–carbon awareness and low acceptance of new agricultural technologies and methods have also restricted the development of the low–carbon agricultural economy (Wang Yinghui, 2024) [4].

4. Features of the animal husbandry process

Animal production is a significant source of greenhouse gas (GHG) emissions worldwide. Depending on the accounting approaches and scope of emissions covered, estimates by various sources (IPCC, FAO, EPA or others) place livestock contribution to global anthropogenic GHG emissions at between 7 and 18 percent [9].

The link between animal husbandry and the state of the environment is undeniable, as the breeding of livestock and poultry naturally entails an increase in greenhouse gas emissions. The increase in the carbon footprint in the livestock industry is attracting more and more attention due to the significant share of these emissions in the global volume. Animal husbandry makes the greatest contribution to atmospheric pollution in agriculture. For China, the world's leading producer of livestock products, reducing carbon emissions has become an urgent scientific task necessary for the harmonious development of the economy and the environment, as well as to counter global climate change. In parallel with the intensive development of animal husbandry, various wastes generated during the maintenance of livestock and poultry have rapidly become one of the main factors of environmental pollution in the agricultural sector [10], [11].

3. Strategies for the development of low–carbon agriculture

In response to the challenges faced by the development of low–carbon agriculture, scholars have proposed a variety of strategies.

– Developing ecological agriculture and promoting energy–saving and emission–reduction technologies

Developing ecological agriculture and promoting organic farming are important strategies for achieving low–carbon transformation of agriculture. Ecological agriculture emphasizes utilizing the self–regulating capacity of the ecosystem, reducing external inputs, and achieving harmonious development of agricultural production and the ecological environment. Specific measures include promoting biological control technology, adopting crop rotation and other planting patterns, and developing ecological circular agriculture (Zheng Xueming, 2024) [1] . At the same time, promoting energy–saving and emission reduction technologies and improving resource utilization efficiency are also key strategies. For example, in terms of irrigation, promote high–efficiency water–saving irrigation technologies such as sprinkler irrigation and drip irrigation, in terms of fertilization, promote soil testing and formula fertilization technology, and in terms of agricultural machinery, promote agricultural machinery operation positioning technology (Zheng Xueming, 2024; Wang Haixia, 2023) [1],[3].

– Optimizing the agricultural industrial structure and strengthening scientific and technological innovation

Optimizing the agricultural industrial structure and developing circular agriculture are important ways to achieve low–carbon transformation of agriculture. Adjusting the structure of planting industry, promoting the development of animal husbandry towards scale and standardization, developing ecological breeding, extending the agricultural industrial chain, and developing agricultural product processing industry and agricultural service industry (Zheng Xueming, 2024) [1]. In addition, strengthening agricultural scientific and technological innovation and developing smart agriculture are also important supports for transforming the mode of agricultural economic development. Smart agriculture uses modern information technologies such as the Internet of Things, big data, and artificial intelligence to achieve precise, intelligent, and visual management of agricultural production (Zheng Xueming, 2024; Wang Haixia, 2023) [1], [3].

– Improve the policy support system and promote agricultural carbon neutrality demonstration projects

Improving the policy support system is the key guarantee for ensuring the transformation of the agricultural economic development mode. The government should increase financial support, innovate financial services, establish an agricultural carbon sink trading mechanism, improve subsidy policies, and strengthen talent training (Zheng Xueming, 2024) [1]. In addition, promoting agricultural carbon neutrality demonstration projects is also an innovative measure to transform the agricultural economic development mode. By establishing demonstration areas, exploring feasible paths for agriculture to achieve carbon neutrality, and providing practical guidance for the low–carbon transformation of agriculture across the country (Zheng Xueming, 2024) [1].

– Strengthening greenhouse gas regulation and expanding the application of recycling technologies

Strengthen greenhouse gas regulatory measures, establish a comprehensive greenhouse gas emissions database, adopt modern technologies and methods to monitor greenhouse gas emissions, establish an emissions trading system, and

formulate strict emission standards and regulations (Zhu Lihong, 2024) [5]. At the same time, expand the application of recycling technology in agriculture, increase investment in scientific and technological research and development, establish a recycling technology promotion mechanism, and encourage farmers and agricultural enterprises to actively adopt recycling technology from the aspects of policy guidance, financial support, and technical training (Xu Wanjin, 2024; Zhu Lihong, 2024) [2], [5].

– Improving agricultural carbon sequestration capacity and enhancing low–carbon awareness

Improve agricultural carbon sequestration capacity, enhance the carbon sequestration capacity of farmland soil, increase soil organic matter content, implement conservation tillage, promote straw return to the field, explore new technologies for biocarbon return to the field and carbon fixation fertilizer, develop advanced soil carbon sequestration technology, and establish a complete farmland carbon monitoring and assessment mechanism (Chen Kaili, 2025) [8]. In addition, enhance farmers' low–carbon awareness, through publicity and education activities and low–carbon technology training, make farmers fully aware of the importance of low–carbon economy, establish the concept of low–carbon production and low–carbon consumption, and actively integrate low–carbon concepts into daily agricultural production and life (Wang Yinghui, 2024; Zhu Lihong, 2024) [4], [5].

In summary, the transformation of agricultural economic development mode under the background of low–carbon economy is a complex system project, involving agricultural production methods, resource utilization efficiency, industrial structure, ecological environment, technology application, policy support and other aspects. Through the development of ecological agriculture, promotion of energy–saving and emission reduction technologies, optimization of industrial structure, strengthening scientific and technological innovation, improving the policy support system, promoting agricultural carbon neutrality demonstration projects, strengthening greenhouse gas supervision, expanding the application of recycling technology, improving agricultural carbon sink capacity, and enhancing low–carbon awareness, agricultural carbon emissions can be effectively reduced, resource utilization efficiency can be improved, and the green transformation of agricultural economy can be achieved. However, this transformation process requires the joint efforts of all parties including the government, enterprises, and farmers, as well as the support and guarantee of relevant policies. Future research can further explore the specific application and effect evaluation of these strategies in different regions and different agricultural types, and provide more scientific and specific guidance for the low–carbon transformation of agriculture.

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