Study on the Coordinated Relationship between Green Agricultural Development and Ecological Economy

Xiuqin Hao*

The People's Government of Linyi Town, Linyi County, Dezhou, 251500, China
**Corresponding author: 691259383@qq.com*

Abstract: *As a crucial pathway to promote sustainable agricultural development, green agriculture emphasizes enhancing ecosystem stability and functional diversity while ensuring economic benefits, facilitating the transition towards resource-efficient and environmentally friendly production methods. Ecological economics provides a scientific framework for the development of green agriculture, stressing that economic activities must achieve resource recycling and environmental protection within ecological carrying capacity. This study systematically analyzes the core characteristics of green agriculture and the theoretical foundations of ecological economics, explores their intrinsic coupling mechanisms, constructs an evaluation system for the coordination between green agriculture and ecological economy, and proposes optimized technological pathways and industrial restructuring strategies to achieve a dynamic balance between ecological environmental capacity and economic carrying capacity. Research indicates that green technology innovation and the optimized utilization of ecological resources are key to realizing the synergistic development of agricultural ecology and economy. Collaborative optimization pathways can promote the green transformation of the agricultural industry chain and enhance regional ecosystem functions. This paper offers theoretical support and practical guidance for the coordinated development of green agriculture and ecological economy, advancing agriculture towards efficient, low-carbon, and circular sustainable development.*

Keywords: *green agriculture; ecological economy; coordinated development; technological pathways; ecological environmental capacity; industrial structure*

Introduction

In the context of increasingly severe global resource constraints and environmental pressures, traditional agricultural production models face severe challenges, and the development of green agriculture has become an essential pathway to achieving the dual goals of agricultural ecological security and economic benefits. Green agriculture not only embodies the protection and restoration of agricultural ecosystems but also represents the core trend of agricultural modernization transformation. At the same time, ecological economics, as an interdisciplinary field of economic development and environmental protection, emphasizes that economic activities should be embedded in natural ecosystems to promote the recycling of resources and the maximization of ecosystem service value. Studying the coordinated relationship between green agriculture and ecological economics has significant theoretical and practical value, as it helps to reveal the intrinsic coupling mechanisms between agricultural ecosystems and economic systems, guide green agricultural technology innovation and industrial structure adjustment, achieve efficient synergistic development of agricultural economy and ecological environment, and promote the construction of ecological civilization and the implementation of sustainable development strategies at regional and even national levels.

1. Analysis of the Theoretical Basis of Green Agricultural Development and the Connotation of Ecological Economy

1.1 Definition and Characteristic Analysis of Green Agricultural Development

Green agricultural development, as a core pathway for sustainable agricultural development in the new era, aims to construct an agricultural production system that balances economic benefits and ecological benefits. Its essence lies in promoting the stability and diversity of agricultural ecosystems

through scientific and rational resource allocation and technology application, while minimizing the negative impact of agricultural activities on the environment. Green agriculture is not limited to reducing the use of pesticides and fertilizers; it also encompasses soil health maintenance, efficient water resource utilization, biodiversity conservation, and the recycling and reuse of agricultural waste. This development model emphasizes the positive interaction between agricultural production activities and natural ecological processes, and through ecological engineering technologies and modern agricultural informatization means, it achieves the dual enhancement of production efficiency and environmental protection, promoting the transition of agriculture towards green and low-carbon development.

The core characteristics of green agriculture manifest as an organic unity of systematicness, coordination, and innovation. Systematicness is reflected in the ecological linkage of all aspects of agricultural production, by constructing material circulation chains within the agricultural ecosystem, forming a stable and self-regulating ecological network. Coordination is embodied in the balance between economic goals and ecological goals, achieving the simultaneous advancement of agricultural economic growth and ecological environmental protection. Innovation requires, on the basis of traditional agriculture, integrating modern biotechnology, intelligent monitoring, and precision management technologies to optimize production structure and processes, thereby improving resource utilization efficiency and environmental adaptability. The development of green agriculture not only focuses on output benefits but also emphasizes the ecological safety of agricultural products and their continuous contribution to regional ecosystems, demonstrating high potential for sustainable development[1].

1.2 The Fundamental Theoretical Framework of Ecological Economy

As an interdisciplinary theoretical system, ecological economy profoundly reveals the inherent connections and mutual constraints between economic activities and natural ecosystems. Its core theoretical foundations include natural capital theory, ecosystem service valuation, and environmental carrying capacity analysis. Natural capital serves as the fundamental asset of ecological economy, encompassing key elements such as land resources, water resources, biodiversity, and atmospheric environment, whose integrity and sustainability directly impact the long-term development capacity of economic systems. Ecosystem service theory emphasizes the multiple service functions that ecosystems provide for human economic and social activities, including water purification, climate regulation, soil conservation, and biodiversity maintenance. The economic value of these ecological services is often overlooked in traditional economic accounting systems, while ecological economics promotes the protection and rational utilization of ecosystem services by assigning them monetary value. Environmental carrying capacity research establishes ecological safety boundaries for economic activities, quantifying the maximum economic pressure that the natural environment can withstand, thereby avoiding resource overload and ecosystem degradation, and providing scientific basis for achieving the balance between economic development and environmental protection.

Building on this foundation, ecological economic theory further emphasizes that economic systems must be embedded within the overall ecosystem structure to achieve dynamic balance in resource flows and material cycles, breaking through the limitations of traditional linear growth models. Focusing on green technology innovation, circular economy models, and low-carbon development strategies, ecological economics promotes the transformation of economic structures toward greater ecological friendliness and resource efficiency, emphasizing the quality rather than merely the quantity of economic growth. Its multi-objective optimization decision-making framework simultaneously considers economic benefits, environmental quality, and ecological health improvement. By coordinating the needs of different stakeholders, it achieves the organic integration of ecological environmental protection and economic benefits. This theoretical system not only provides solid theoretical support for the development of green agriculture, enabling agricultural production activities to operate efficiently within ecological carrying capacity limits, but also promotes the functional enhancement of agricultural ecosystems and the maximization of their economic value. Consequently, it achieves dual wins in both environmental protection and economic development, promoting the sustained and healthy development of agriculture and ecological economy[2].

1.3 The Intrinsic Linkage Mechanism Between Green Agriculture and Ecological Economy

The connection between green agriculture and ecological economy is manifested through the direct impact of agricultural ecosystem health on the stability and sustainability of the ecological economic

system. Green agriculture enhances soil biodiversity and ecosystem self-restoration capacity by reducing chemical inputs and improving ecological service functions, thereby promoting the protection and appreciation of natural capital. As the fundamental unit of ecological economy, the functional optimization of agricultural ecosystems enhances the quality of ecosystem services, providing lasting resource support and environmental guarantees for regional economies. The transformation in production methods within green agriculture, such as ecological planting, multi-tiered agriculture, and circular agriculture, significantly improves the comprehensive resource utilization rate and ecosystem stability, propelling ecological economic development onto a virtuous cycle track.

From the perspective of ecological economy, green agriculture serves not only as a maintainer of ecosystems but also as a promoter of ecological capital appreciation. The application of ecological design principles in agricultural production activities makes resource flows within the ecological economic system more rational and efficient, reducing environmental burdens and achieving coupled coordination between agricultural economy and ecological environment. Through the establishment of agricultural ecological compensation mechanisms and payment systems for ecological services, green agriculture can internalize environmental costs and promote the sustainable expansion of ecological economy. The deepening of their relationship is further reflected in how green agricultural technological progress drives the restructuring of the ecological economy, facilitating green upgrading and circular development of economic structures. The system perspective emphasizes the multi-level coupling relationship between green agriculture and ecological economy, promoting the construction of resource-saving and environment-friendly agricultural production systems, thereby providing solid support for high-quality development of regional and even global ecological economy.

2. Analysis of Green Agricultural Development Models and Ecological Economy Coordination Pathways

2.1 Green Agricultural Technology Pathways and Optimization of Ecological Resource Utilization

The core of constructing green agricultural technology pathways lies in significantly enhancing the ecological efficiency and resource utilization effectiveness of agricultural production systems through the integrated application of multidimensional ecological technologies. Modern green agricultural technologies encompass biological pest control, precision fertilization, water-saving irrigation, soil improvement, and agricultural waste recycling, among other aspects. The scientific integration of these technologies not only reduces dependence on chemical pesticides and fertilizers, effectively alleviating environmental pressure on agricultural ecosystems, but also promotes the transformation of agricultural production from traditional resource-intensive models to green and low-carbon types. By strengthening the closed-loop mechanisms of energy flow and material circulation within agricultural ecosystems, green technology pathways achieve multifunctional composite utilization of production processes, enhancing the self-regulating capacity and stability of farmland ecosystems. These technology pathways emphasize systematicness and synergy, fostering positive interaction between agricultural production and ecological processes, thereby establishing a solid technical foundation for sustainable agricultural development[3].

The optimization of ecological resource utilization must balance the renewability of resources with the constraints of ecological environmental capacity, ensuring that agricultural production activities maximize benefits within ecological carrying capacity limits. The introduction of intelligent monitoring and information management systems enables dynamic regulation of agricultural production parameters, improving water and fertilizer use efficiency and land utilization efficiency while reducing resource waste and environmental pollution risks. Innovative green technology pathways are also reflected in promoting diversified crop planting models and multi-tiered agricultural systems. By increasing the complexity and diversity of ecosystems, these approaches enhance overall stress resistance and ecological stability. This technological innovation drives the transformation of agricultural production from traditional over-reliance on resources to ecological intensification, promoting coordinated symbiosis between agricultural production and regional ecological economy, ultimately achieving synergistic value addition of ecological and economic benefits, and advancing green agriculture toward a high-quality development stage.

2.2 Adjustment of Green Agricultural Industrial Structure and Its Coupling with Ecological Economic Structure

The adjustment of the green agricultural industrial structure constitutes a crucial component in achieving sustainable agricultural development, with its core focus on optimizing industrial layout and product structure to enhance the ecological adaptability and economic resilience of agricultural systems. This structural adjustment should be grounded in increasing the proportion of ecological products, promoting ecological planting, ecological breeding, and circular agriculture to form a green industrial chain encompassing production, processing, distribution, and consumption. This adjustment not only helps reduce environmental load and improve resource utilization efficiency but also drives the transformation and upgrading of the agricultural economy through high-value-added products from ecological agriculture industries. The greening transformation of the industrial structure promotes the strengthening of ecological functions in agricultural systems, thereby enhancing the coordination and stability of the overall ecological economic system.

The optimization of industrial structure must be coupled with changes in regional ecological economic structure, forming a positive interaction between agricultural production and ecological service functions. The adjustment of ecological economic structure requires greater emphasis on ecological environmental maintenance and sustainable resource utilization throughout industrial chain links, making green agricultural development an important component of the ecological economic system. The dynamic coupling relationship between industrial structure and ecological economic structure manifests through the spatial rationality of industrial layout, the diversity of product structure, and the ecological adaptability of industrial activities. Coordinated promotion of green agricultural industrial structure adjustment helps achieve optimal allocation of ecological resources and green transformation of regional economy, thereby establishing a solid foundation for the robust development of ecological economic systems[4].

2.3 Balance Analysis Between Ecological Environmental Capacity and Economic Carrying Capacity in Green Agriculture

Ecological environmental capacity serves as a key indicator for measuring the pressure that ecosystems can withstand from economic activities, determining the sustainable boundaries of green agricultural development. While pursuing economic benefits, agricultural activities must adhere to the constraints of ecological environmental capacity to prevent resource overload and environmental degradation. By enhancing production technology efficiency and adjusting agricultural structure, green agriculture effectively reduces damage to land, water bodies, and biodiversity, thereby ensuring the stability of ecological environmental capacity. The scientific assessment of ecological environmental capacity requires comprehensive consideration of multidimensional factors such as land quality, water resource conditions, and ecosystem health, establishing a dynamic monitoring system for environmental capacity applicable to green agriculture, and supporting the orderly conduct of agricultural production activities within ecological carrying capacity limits.

Economic carrying capacity reflects the potential and space for sustainable development of agricultural economic systems under existing ecological environmental conditions. The development of green agriculture requires reasonable alignment of economic growth rates with ecological environmental protection requirements to achieve coordinated unity of economic and ecological benefits. Through the construction of ecological economic models and data analysis, we can quantify the impact of agricultural economic activities on ecological environmental capacity, guiding rational control of agricultural production scale and intensity. Balancing ecological environmental capacity and economic carrying capacity can effectively avoid environmental problems caused by excessive agricultural development, promote long-term stable coexistence between agriculture and ecosystems, and establish a solid foundation for high-quality development of ecological economy.

3. Construction of the Coordination Evaluation System and Optimization Strategies for Green Agriculture and Ecological Economy

3.1 Design of the Coordination Evaluation Indicator System for Green Agriculture and Ecological Economy

The construction of the coordination evaluation indicator system for green agriculture and

ecological economy must be based on systems science and ecological principles, comprehensively reflecting the inherent connections and interactions among agricultural ecological environment quality, resource utilization efficiency, and economic benefits. The design of the indicator system should comprehensively cover ecological resource carrying capacity, agricultural ecological service functions, the adoption rate of green technologies, and the greening degree of the agricultural economic structure. Ecological resource carrying capacity indicators focus on assessing soil fertility maintenance, water purification capacity, and biodiversity conservation levels, reflecting the pressure and impact of agricultural activities on natural capital. Agricultural ecological service function indicators, from perspectives such as ecosystem regulation, carbon sequestration function, and environmental pollution mitigation capacity, reveal the supporting role of green agriculture for the stability and sustainability of the ecological economic system. Green technology application indicators evaluate the scope and depth of technologies including precision agriculture, biological pest control, and water-saving irrigation, quantifying the contribution of technological progress to the green transformation of agricultural production[5].

Economic benefit indicators focus on the quality and efficiency of agricultural economic growth, particularly the market share of ecological products and their value-added levels, reflecting the competitiveness and sustainable development potential of green agriculture within the economic system. The construction of the indicator system should balance the availability of quantitative data with the comprehensive evaluation of qualitative analysis, ensuring the scientific nature, objectivity, and adaptability of the evaluation results. By introducing multi-indicator comprehensive evaluation methods, we can achieve dynamic diagnosis and multi-dimensional monitoring of the coordinated development of green agriculture and ecological economy. This helps identify structural contradictions and bottleneck issues during the development process, providing a solid data foundation and theoretical support for optimizing development strategies, and promoting the organic integration and synergistic evolution of agricultural ecosystems and regional economic systems.

3.2 Measurement Methods for the Coordinated Development Level of Green Agriculture and Ecological Economy

The measurement of the coordinated development level between green agriculture and ecological economy requires the adoption of a multidimensional evaluation model that integrates statistical analysis and system dynamics methods to dynamically reflect the interactive relationship and development trends between the two. Based on the coupling coordination degree model, this measurement constructs indicator sets for green agricultural development and ecological economy, employs normalization processing and the analytic hierarchy process to determine weights, and achieves scientific integration and quantitative evaluation of indicator data. The coupling degree is used to measure the intensity of mutual influence between green agriculture and the ecological economic system, revealing the interdependence between the systems; the coordination degree reflects the consistency and synchronization of the development of the two systems, serving as a core indicator for evaluating the overall operational efficiency and health of the systems. This measurement method can accurately quantify the promoting effect of green agricultural development on the ecological economic system and its stability level.

Further introduction of time-series data and multi-factor comprehensive impact models can capture the dynamic evolution trajectory and potential risks in the coordinated development of green agriculture and ecological economy. By combining the fuzzy comprehensive evaluation method with the analytic hierarchy process, subjective deviations in the setting of indicator weights are resolved, enhancing the reliability and scientific rigor of the measurement results. Constructing a multi-level, multi-perspective evaluation framework not only helps identify the strengths and weaknesses of the current coordinated development level but also predicts future development trends, providing a scientific basis for formulating precise regulatory policies and optimizing adjustment pathways, thereby promoting higher-quality synergistic evolution and sustainable development of green agriculture and ecological economy.

3.3 Optimization Pathways for Promoting Efficient Synergy between Green Agriculture and Ecological Economy

Constructing optimization pathways for efficient synergy between green agriculture and ecological economy must be based on a systemic perspective, strengthening the organic integration of green agricultural technology innovation and ecological resource recycling. Innovative technology integration

should cover areas such as biological pest control, precision agriculture, energy conservation and emission reduction, and waste resource utilization, promoting the green transformation and upgrading of the entire agricultural production process. Simultaneously, by optimizing the coordinated development of upstream and downstream links in the agricultural industry chain, we can enhance the release capacity of ecological service functions and facilitate bidirectional improvement of ecological and economic benefits. Strengthening the linkage mechanism between agricultural ecosystems and regional ecological economic networks, while promoting information sharing and resource integration, helps enhance the system's adaptability, resilience, and overall robustness, ensuring the stable operation of the agricultural ecological economic system[6].

Furthermore, the optimization pathways emphasize institutional innovation and the scientification of management models, promoting the dynamic balance between ecological environmental capacity and economic carrying capacity. The construction of a multi-level collaborative governance framework helps achieve rational allocation and sustainable utilization of ecological resources in agricultural production activities. Guided by ecological economic theory, we should promote continuous innovation in green agricultural production models and the improvement of green value chains, constantly enhancing the level of agricultural greening and the quality of economic benefits. The dynamic adjustment and coordination mechanism facilitates the deep integration and symbiotic mutual benefit between green agriculture and the ecological economic system, providing strong support for the construction of agricultural ecological civilization and the green transformation of the regional economy, thereby assisting agricultural ecosystems to move towards a new stage of efficient, low-carbon, and circular sustainable development.

Conclusion

This paper systematically elaborates on the intrinsic linkage mechanism between green agriculture and ecological economy, starting from the theoretical foundation of green agricultural development and the connotation of ecological economics. It constructs a coordination evaluation indicator system and measurement model, while proposing optimization pathways centered on green technology innovation and industrial structure adjustment. Research demonstrates that the development of green agriculture not only promotes the functional enhancement of agricultural ecosystems but also strengthens the stability of ecological economic systems, achieving the dual objectives of resource conservation and environmental protection. Future research should further deepen the coordination mechanism between green agriculture and ecological economy from multi-scale and multi-system perspectives, explore the application of information and intelligent technologies in agricultural ecological economic systems, and strengthen the dynamic management and assessment of ecological capital. Promoting the deep integration of green agriculture and ecological economy will help construct a resource-saving and environment-friendly modern agricultural production system, facilitate the green transformation and upgrading of regional economies, and support the sustained healthy development of agricultural ecological civilization.

References

[1] Dong Jie. "The Green Development Path of Rural Economy under the Background of Rural Revitalization." Shanxi Agricultural Economy .14(2025):142-144.
[2] Li Hailian, and Zhou Haiying. "Research on the Role of Green Ecological Agriculture in the Sustainable Development of Agricultural Economy." Shanxi Agricultural Economy .04(2025):139-141.
[3] Song Jie. "Development Models of Green Ecological Agriculture in Agricultural Economy." Rural Scientific Experiment 03(2025):102-104.
[4] Hu Rujie. "Research on Green Agricultural Development Strategies from the Perspective of Rural Revitalization Strategy." Guangdong Sericulture 58.11(2024):125-127.
[5] Liang Yicun. "Discussion on Rural Industrial Transformation and Economic Development Paths under the Background of Green Development." Agricultural Machinery Use and Maintenance .10(2024):57-59.
[6] Xu Xiaoyu. "The Dynamic Mechanism and Implementation Path of Coordinated Development between Agricultural Economy and Green Economy." Advisor of Rural Household .26(2024):11-13.