The Impact of Financial Support Mechanisms on the Green Transformation of China's Agriculture

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Abstract. The green transformation of agriculture is the core approach to achieving the deep integration of the "dual carbon" goals with the rural revitalization strategy. It faces multiple constraints such as insufficient capital investment, weak risk prevention and control, and difficulties in realizing ecological value, and the effective support of the financial system is indispensable, such as funds, risks, and motivation. A systematic review of relevant studies at home and abroad focuses on three core policy tools: green credit, green insurance, and market incentive tools, to clarify their respective functional positioning, synergy logic, and practical challenges. The review found that the existing literature has constructed a theoretical support framework, namely "funding supply - risk dispersion - benefit incentives" but generally pointed out that the main shortcomings of the current system are insufficient synergy among tools, lack of standards, and limited inclusiveness. By integrating existing views, the aim is to provide a systematic analytical perspective on the agricultural green finance support system, as well as references for subsequent research and practice.

Keywords: Agricultural Green Transformation; Green Credit; Green; Agricultural Insurance.

1 Introduction

China has committed to peaking carbon emissions before 2030 and achieving carbon neutrality before 2060. The green transition in the agricultural sector faces more complex challenges than in the industrial sector. China needs to promote the green and low-carbon transformation of agriculture on the premise of ensuring absolute food security, which is a big change concerning national strategic security. Agriculture and land use change contribute about 25 percent of greenhouse gas emissions globally and are a key area for reducing emissions. China's agricultural transformation also needs to take into account resource and environmental constraints as well as the responsibility of a major country in global climate governance, and its progress cannot do without financial support. The green transformation of agriculture has been incorporated into the country's top-level design and is clearly deployed in the 14th Five-Year Plan and the rural revitalization strategy. As a systematic project, it involves three key elements:

© The Author(s) 2026
L. C. Yoong (ed.), *Proceedings of the 2026 2nd International Conference on Financial Innovation and Marketing Management (FIMM 2026)*, Advances in Economics, Business and Management Research 408,
https://doi.org/10.2991/978-94-6239-801-6_86

the transformation of small-scale farmers' behavior, long-term land investment, and climate risk management. Smallholders' shift to green farming can lay a solid micro foundation, long-term land investment can enhance the ecological stability of farmland, and climate risk management will safeguard the transition. The project requires high upfront investment, has a long payback period and has ecological positive externalities, which can lead to market failure and urgently requires appropriate financial support mechanisms. Although there has been an accumulation of relevant practices and research in recent years, the existing studies have mostly remained at the level of description of a single tool or superficial coordination of policies, lacking a systematic framework to examine the correlation of tools, making it difficult to solve the problem of insufficient precise policy implementation. Therefore, through a systematic literature review and framework reconstruction, this paper identifies core financial tools, reveals their mechanisms of action, and proposes an integrated analysis framework and policy recommendations to provide theoretical support for ensuring food security and promoting agricultural carbon peaking and rural green revitalization.

However, upon closer examination, most studies remain at the level of describing the function of a single tool or superficial coordination among different policies, either arguing in isolation the role of "insurance + futures" or broadly calling for "multi-synergy", but rarely questioning whether there is an inherent logic of functional complementarity among different financial tools. How do they work together on specific stages and specific subjects in the green transition of agriculture? In other words, there is a lack of a systematic framework to examine the "relevance" of tools, and even less critical integration. Such fragmentation makes it difficult to address the reality of an abundance of tools but a lack of precise policy-making capabilities. Therefore, through a systematic literature review and framework reconstruction, this paper responds to the core question: Which financial tools are the pillars of the green transformation of agriculture, and through what logical chains do they reinforce each other? This paper not only identifies the key tools but also reveals the intrinsic mechanisms by which they fit into the green transformation of agriculture. Based on this, an exploratory and integrated analytical framework is proposed, and suggestions are provided for optimizing policy design, with the aim of providing theoretical support for achieving carbon peaking in agriculture and promoting green revitalization in rural areas while ensuring food security.

2 Financing Support: The Foundational Role of Green Credit

The green transformation of agriculture cannot do without the support of a diversified funding allocation mechanism. Green credit, green bonds and digital inclusive finance provide financing guarantees from different dimensions and jointly promote the green development of agriculture.

2.1 Funding Allocation Mechanism

Green credit is the core financial instrument, covering differentiated interest rate loans, "credit + insurance" linkage models and special product innovations [1]. Differentiated interest rates and flexible repayment periods are targeted to support environmental protection projects, and the "credit + insurance" model enhances credit with agricultural insurance to make up for the shortage of collateral for farmers [2]. In practice, products such as "Two Mountain White Tea Loan" are precisely targeted by insurance credit enhancement to support green production-related demands [3], but the lack of uniform green standards and the imperfect credit system restrict their effectiveness. Green bonds, as medium - to long-term tools, are divided into traditional asset securitization and blockchain decentralization, both of which need to be certified by the climate bond standard. They aggregate cash flows from small green projects to form an investment pool and provide targeted support for climate-adaptive infrastructure [4]. The decentralized model can reduce financing costs. But the lack of project standardization and limited liquidity has hindered promotion. Digital inclusive finance, relying on digital technology to break through time and space limitations, significantly enhances agricultural green total factor productivity [5], generates positive effects through optimizing the industrial structure, approximately 8.42% of the effects result from the optimization of the industrial structure, its effects are regionally heterogeneous, and the digital divide and imperfect infrastructure still constrain efficiency. The three work together to form a complementary closed loop: Green credit provides immediate start-up funds, alleviating the shortcoming of long green bond issuance cycles; Digital inclusive finance optimizes the business environment, reduces the risk of credit default and enhances bond attractiveness. In summary, the three types of mechanisms have their own focuses and work together to build a funding allocation system that fits the green transformation of agriculture.

2.2 Risk Prevention and Control Mechanism

The prevention and control of risks in the green transition of agriculture rely on the synergy of green insurance and policy-based guarantees, which together form the core mechanism of risk assumption and facilitate the transition. Green insurance assumes the core risk protection function, and its support paths are mainly reflected in two aspects. Directly disperse risks such as natural disasters and market fluctuations, stabilize farmers' production expectations, encourage green production investment and work in synergy with green credit as a credit enhancement tool to improve the availability of funds, indirectly promote the adoption of green technologies (Mao et al., 2022). In practice, green insurance products have continued to innovate, extending from traditional cost insurance to special types such as meteorological index insurance and carbon sink insurance, and the coverage scenarios have been continuously expanded. However, development is still constrained by multiple factors. There is insufficient benign interaction between green insurance and green credit, and the synergy effect has not been fully released. The "cold supply and demand" situation is prominent [6]. Coupled with market problems such as adverse selection and moral hazard, the data basis for product innovation is weak and farmers' willingness to pay is limited, which

affects the effectiveness of policies. Policy-based guarantees, as an important supplement, share the risk of green credit through policies, lower the financing threshold for small and medium-sized farmers and new agricultural business entities, and focus on supporting projects such as green technology research and development and investment in environmental protection facilities. Its core role is to make up for the insufficiency of collateral and boost the confidence of financial institutions in lending, but currently, there are problems such as limited coverage, cumbersome guarantee process and imperfect risk compensation mechanism, which make it difficult to fully match the diversified risk-sharing demands of agricultural green transformation. In summary, green insurance and policy-based guarantees have different focuses in terms of risk dispersion and financing credit enhancement, but both face problems such as insufficient mechanism coordination and obvious practical constraints. It is necessary to strengthen the linkage between the two through optimizing product design, improving compensation and other mechanisms to form a risk-sharing synergy.

2.3 Value Incentive Mechanism

The core of the value incentive mechanism is to transform the ecological benefits of agricultural green transformation into economic gains, forming a positive market-oriented cycle of "transformation equals benefit", and promoting the transformation from policy-driven to market-driven. Carbon sink finance is a key carrier for realizing ecological value by incorporating agricultural carbon sinks into the green evaluation system and relying on the carbon trading market to achieve the economic transformation of ecological benefits [7]. Empowered by digital technology, carbon sink finance links agricultural production with carbon trading scenarios through innovative products such as carbon accounts and carbon emission reduction loans, helping business entities gain additional income through low-carbon planting and carbon sink cultivation. In practice, core enterprises and financial institutions have linked carbon sink performance with financing incentives to further encourage farmers to participate in carbon sink projects and enhance the market-based incentive effect of green production. Supply chain finance, relying on the credit transmission of core enterprises, plays a key role in green inclusive integration and provides appropriate green financing services for small and micro enterprises on the chain [1]. It guarantees targeted support for green production by closing the capital flow and verifying the real trade background, but still faces multiple challenges. The current green standards are difficult to meet the working capital needs of small and micro enterprises, and there is a lack of special incentive policies; Financial institutions have difficulty obtaining green verification data and have insufficient understanding of the green attributes of the industrial chain. The two types of tools stimulate transformation momentum through market-based revenue transfer, but problems such as standard adaptation, data support and willingness enhancement need to be addressed in order to fully unleash the value incentive effect and consolidate the long-term effectiveness of agricultural green transformation.

3 Analysis of the Role of Financial Support Mechanisms

The financial support mechanism acts on the green transformation of agriculture through three core dimensions: environmental governance, production efficiency improvement, and rural development empowerment. Its pathways and effectiveness

have been widely verified in the existing literature. The following is a systematic analysis in combination with specific research.

3.1 Environmental Governance Effects: Carbon Emission Reduction and Agricultural Pollution Control

The improvement effect of the financial support mechanism on the agricultural environment is concentrated in carbon emission reduction and non-point source pollution control, laying a solid ecological foundation for the green transformation. Research based on data shows that green finance has a one-way causal relationship with agricultural carbon emissions and fertilizer use. It can significantly reduce agricultural carbon emissions by suppressing excessive fertilizer input, with a contribution of 4.34% to carbon emissions change and an even higher contribution of 11.37% to fertilizer use change [8]. Another empirical study further confirmed that green finance not only directly reduces the intensity of agricultural non-point source pollution, but also plays an indirect role in pollution control by encouraging farmers to reduce chemical inputs such as pesticides and adopt green production technologies, and the improvement of digital infrastructure can significantly amplify this governance effect [9]. The two types of studies together reveal that financial support builds a multi-faceted mechanism for agricultural environmental governance through a dual approach of direct intervention at pollution sources and indirect guidance of production behavior. The core logic is to internalize environmental costs through financial tools, change the cost-benefit structure of agricultural production, and thereby drive pollution reduction. However, existing research also points out that factors such as insufficient regional innovation capacity and lagging digital infrastructure will restrict the effectiveness of emissions reduction, and the potential for environmental governance needs to be further released through mechanism optimization.

3.2 Productivity Enhancement Effects: Industrial Structure Optimization and Total Factor Productivity Growth

Financial support mechanisms, through resource reallocation and technological innovation empowerment, have become a key support for optimizing the agricultural industrial structure and enhancing production efficiency. Empirical tests using the fixed effects model show that green finance can significantly promote the upgrading of the agricultural industrial structure by directing funds to low-carbon green industries and restricting the expansion of high-carbon industries, and this promoting effect is more prominent in the eastern region due to mature financial markets and superior resource endowments [10]. Research focusing on digital finance has found that its coverage breadth, usage depth and digitalization level can positively enhance agricultural green total factor productivity. The core mechanism is to improve the misallocation of agricultural production resources and promote agricultural technological innovation, and it has a more significant promoting effect on the progress and efficiency improvement of agricultural green technology in major grain-producing areas [11]. The study confirmed that financial support has laid a solid economic foundation for the green transformation of agriculture through both structural adjustment and efficiency

improvement. The essence is to drive the transformation of agriculture from traditional extensive production to technology-intensive, low-carbon and efficient production through the targeted allocation of financial resources. But the problem of development imbalance caused by regional heterogeneity is more obvious, and differentiated policies need to be formulated based on the financial development level and agricultural basic conditions of different regions to break the imbalance.

3.3 Rural Development Empowerment Effect

Financial support mechanisms extend to micro-subjects and the overall rural development, empowering rural revitalization in all aspects by guiding farmers' production decisions and alleviating development constraints. Research based on the mediating effect framework shows that green finance not only directly promotes carbon reduction in agriculture but also indirectly drives the transformation of farmers' production methods through optimizing the agricultural industrial structure and guiding agricultural technological progress, contributing to the realization of the goals of ecological livability and industrial prosperity in rural areas [12]. Another study pointed out that the coupling and synergy of technology finance and green finance can effectively alleviate rural financing constraints, strengthen the connection between small-scale farmers and modern agriculture through the cultivation of green agricultural cooperatives, enhance agricultural green total factor productivity, and provide support for the multi-dimensional goals of rural revitalization [13]. The two types of studies reveal the intrinsic logic of financial support empowering rural revitalization at both micro and macro levels, with the core being to reduce the cost of green transformation for farmers through financial tools, defuse risks, and promote industrial upgrading and ecological improvement in rural areas. But the compatibility of current financial products with farmers' demands and rural realities still needs to be improved, and in the future, the precision and inclusiveness of financial services need to be strengthened to bridge micro production with macro development. In summary, the financial support mechanism plays a significant role in three dimensions: environmental governance, efficiency improvement, and rural empowerment. The three types of effects work together to support the green transformation of agriculture. Although existing research clearly defines its role path, there is still room for expansion in regional differentiated responses and mechanism synergy optimization.

4 Conclusions

This review, through systematic collation and analysis of existing literature, draws the core conclusion: The financial support system for the green transformation of agriculture is not a simple superposition of various tools, but an organic unity with complementary functions and coordinated operation, forming a closed-loop support of "capital supply - risk prevention and control - value incentives". Green credit, as a fundamental financing guarantee, provides core financial support for green agricultural production and technology promotion, while green bonds and digital inclusive finance respectively fill the medium - and long-term funding gap and expand the boundaries of

inclusive services; Market-based tools such as carbon sink finance are linked with green insurance and policy-based guarantees to build a long-term endogenous incentive and risk control mechanism. The academic community has reached a consensus that the role of various financial tools in agricultural environmental governance, production efficiency improvement and rural development empowerment is clear and significant. The core challenge at present is the imbalance in the development of financial tools, insufficient linkage, and limited release of the effectiveness of green bonds and carbon sink finance; The lack of uniformity in agricultural green standards hinders policy implementation and precise allocation of funds; Information asymmetry, weak digital and credit infrastructure in rural areas, and the lack of collateral for small-scale business operators have made it difficult for financial services to effectively reach the grassroots level. Based on this, in the future, need to build a unified green certification standard, deepen fintech to break down information barriers, improve the inclusive mechanism, build a financial service ecosystem that can precisely guide resources to green agriculture and be inclusive of all types of business entities, promote the shift of financial tools from single-point breakthroughs to combination optimization, and enhance the synergy of the mechanism.

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