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Design and Application of Agricultural Guarantee Digital System Platform (Postprint)

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Abstract

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Full Text

Preamble

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Abstract: Modern agriculture requires the support of modern finance. The agricultural credit guarantee system represents an important mechanism for channeling financial capital into the agricultural industry and addressing its financing difficulties and high costs. The design and application of an agricultural guarantee digital system platform not only accelerates the transformation and upgrading of agricultural development models but also holds significant positive implications for steady economic growth, reform promotion, structural adjustment, and livelihood improvement. This paper summarizes relevant literature on agricultural guarantee systems, designs and develops an agricultural guarantee digital system platform based on blockchain and big data technologies, and demonstrates its substantial benefits and positive effects through practice in China.

Keywords: Blockchain; Big Data; Agricultural Guarantee; Digital System

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1 Introduction

Chinese agriculture is characterized by low overall scientific and technological quality, backward production and management modes, small-scale efficiency, long growth cycles, low reproduction rates in agricultural product processing, short agricultural industrial chains, and high risks in agricultural management. These factors create a vicious cycle between agricultural development and the shortage of agricultural labor and capital. Due to the idiosyncratic nature of agricultural production, agricultural business entities face greater difficulty obtaining loans from formal financial institutions compared to other borrowers. Establishing an agricultural credit guarantee system constitutes an effective solution to this problem. Based on a review of domestic and international scholarship on agricultural credit guarantee system construction and application, this study examines relevant policies and practices, and designs and develops a new agricultural guarantee system platform utilizing blockchain technology. This agricultural credit guarantee system has been widely implemented across China with considerable success.

2 Literature Review

Foreign scholars conducted systematic research on credit guarantee theory as early as the 1980s and 1990s, developing a comprehensive theoretical framework. Compared to domestic scholars, foreign researchers have produced more

in-depth and mature studies on credit guarantee theory. Given that information asymmetry and moral hazard are widespread in credit markets—particularly in rural financial markets—agricultural operators face greater challenges than ordinary enterprises in securing loans based on their own credit. Consequently, market mechanisms alone cannot resolve these issues. The rural financial market requires the introduction of third-party agricultural guarantee institutions to mitigate losses caused by moral hazard and information asymmetry. The scholarly consensus holds that moral hazard and information asymmetry are root causes of financing difficulties in agriculture.

Hoff and Stiglitz (1990) argued that loan difficulties between farmers and rural financial institutions stem from adverse selection and moral hazard, both consequences of information asymmetry. Similarly, Stiglitz and Weiss (1992) identified adverse selection and moral hazard arising from information asymmetry as primary causes of farmer financing difficulties. The introduction of credit guarantee institutions can effectively alleviate information asymmetry problems and reduce financing costs. Akerlof (1970) proposed credit guarantee theory based on information asymmetry problems, demonstrating that credit guarantees could eliminate such issues. Stiglitz and Weiss (1992) further argued that only by establishing an agricultural credit guarantee system could the financing challenges facing agricultural enterprises be alleviated. Chan and Kanatas (1985) examined signaling effects of guarantees in credit markets with asymmetric information, analyzing and predicting widespread guarantee usage in bank loans and small business lending within the “middle market.”

Barro (1976) explained how credit guarantees play key roles in financial markets by influencing interest rates, transaction costs, and loan sizes. Zecchini and Ventura (2009) similarly demonstrated in their research on Italy that government guarantees significantly reduce financing costs for insured companies.

3 Study on the Agricultural Guarantee Digital System

Measures to strengthen China’s agricultural credit guarantee system construction are inspired by identifying and addressing problems in rural financial markets, creating urgent demand for rural financial innovation. This section summarizes the rationale for building an agricultural credit guarantee system and reviews relevant research.

3.1 Problems in China’s Rural Credit Market

China’s rural financial market suffers from objective deficiencies. Research by numerous Chinese scholars indicates that structural contradictions in supply and demand, credit line structures, and credit term structures constitute primary problems. Supply-demand structural contradictions are particularly acute. According to Cao Zehui et al. (2012), rural financial institutions cannot effectively meet financing needs for large projects due to low social recognition, limited deposit absorption capacity, small operational scale, and weak financial supply

capacity.

Wang Zhicai et al. (2006) argued that with the reform of the financial institutional system, state-owned commercial banks have gradually shifted their business focus to cities, resulting in capital outflow from rural areas. Zhang Jianning (2012) studied constraints on agricultural cooperatives, identifying single financing channels and limited financing amounts as important factors restricting cooperative development. In China's rural financial market, credit line structural contradictions manifest in standards tied to credit ratings, guarantees, mortgages, and insurance that fail to meet farmers' loan demands. Ren Le et al. (2017) found through Logit and Tobit regression analysis that agricultural insurance could alleviate credit rationing difficulties for farmers, increase agricultural credit availability, and raise loan amounts. Liu Lin (2018) argued that commercial banks generally calculate theoretical credit limits based on high-quality collateral or guaranteed credit lines provided by customers, according to operational characteristics of small and micro enterprises. Liang Hu et al. (2019) used multinomial Logit models to propose that external constraints such as insufficient rural financial services imposed by financial institutions lead to contradictions in credit term structures, making it difficult for farmers to obtain loans or full financing from rural financial institutions. Liang Hu et al. (2019) further noted that rural household loans are primarily used for agricultural production and operation, with small demand scale and mostly medium-term loan expectations, while current rural financial market credit products struggle to meet these demands. Yuan Chunsheng (2014) demonstrated that politically connected companies face lower credit financing costs and find it easier to obtain long-term loans.

3.2 Idiosyncratic Problems in Rural Credit

Idiosyncratic problems in rural financial credit markets primarily stem from agriculture's inherent risks and management risks of agricultural operators. Agriculture faces unique risks including natural and price risks. Zhang Wei et al. (2014) argued that under the dual influence of natural environment and market factors in agricultural production, the risk of agricultural financial products far exceeds that of similar non-agricultural loans. This leads rural financial institutions to impose stricter conditions and smaller loan amounts, resulting in loan supply that fails to meet market demand.

Wu Wei et al. (2017) believed that the liquidity of agricultural risks forces the most vulnerable groups to bear risk consequences, while backward information conditions in rural areas leave market participants lacking effective risk prevention methods. Zhang Yanyuan et al. (2016) argued that beyond natural force majeure risks, new agricultural operators also face increased market risks, technological risks, and social risks, rendering traditional risk response measures inadequate for coping with these multifaceted impacts. The primary reasons Chinese agricultural producers cannot obtain loans from financial markets include their large numbers, weak economic strength, and lack of collateral

property. According to Wu Yuxiang (2012), insufficient collateral in rural areas importantly affects the scale of agricultural operation and level of agricultural production efficiency, representing a fundamental reason agricultural operators cannot obtain financing from rural financial markets.

Liang Hu et al. (2019) argued that farmers' poor economic strength and lack of effective mortgage and collateral make it difficult for them to meet financial institutions' risk control requirements, representing important reasons for rural financial institutions' automatic reduction of agricultural credit supply. Dong Xiaolin et al. (2008), after analyzing the current situation and causes of loan difficulties for agricultural management subjects in China, concluded that solving the mortgage guarantee problem is key to improving farmers' loan access, requiring systemic solutions.

3.3 Construction of Agricultural Credit Guarantee System

Constructing an agricultural credit guarantee system effectively addresses the “difficult loan,” “expensive loan,” and “slow loan” problems in current rural financial markets. Theoretical research on agricultural credit guarantee systems shows that Qin Hongsong (2014) believes farmer guarantee loans provide effective security for farmers under the current rural financial system. Zhao Jinlu et al. (2011) argue that agricultural credit guarantees effectively relieve agricultural credit constraints and farmer loan difficulties, helping advance urban-rural financial integration in China. Li Mingxing et al. (2019) believe that developing policy-based agricultural credit guarantee business represents an innovative extension of China's current financial transfer payments and an inevitable process for perfecting the urban-rural financial system. Qiao Zhen (2013) argues that constructing an agricultural credit guarantee system is key to deepening rural financial and economic development. Similarly, Zhao Xuejun (2014) proposes that the lack of a rural credit guarantee system constitutes one of the root causes of farmer financing difficulties.

Agricultural credit guarantee system construction primarily involves multiple operational participants, risk sharing mechanisms, and financial support capacity for agriculture. Xiao Zongfu et al. (2007) believe it is necessary to build a multi-level innovative guarantee system with perfect supervision and risk sharing mechanisms to leverage agricultural credit guarantee companies and promote rural financial market deepening. Regarding multiple participating subjects, Lin Yifu (2001) believes that establishing agricultural credit guarantee companies and an operational model of “company + farmer + bank financial institution” could effectively solve financing difficulties for agricultural operating subjects in China. Dong Xiaolin et al. (2008) believe the rural guarantee system should be constructed through four operational modes: establishing guarantee funds, establishing guarantee companies based on leading enterprises, establishing financial connection intermediaries, and establishing agricultural insurance. Regarding risk sharing, Li Zhijun (2010) believes that introducing multiple risk-sharing participants to carry out credit default swaps can help reduce risk losses

for participants with low risk tolerance. Ji Qiongliang (2012) studied four insurance types—“Bank Loans and Insurance,” “Guarantee Agencies + Insurance,” “Trade Finance + Insurance,” and “Finance Lease + Insurance”—in small micro enterprise financing models, concluding that establishing a comprehensive financing insurance system involving government, banks, guarantee agencies, and leasing companies to share risks and profits can effectively solve financial institutions’ reluctance to lend. Ma Jiujiu et al. (2016) believe that establishing an agricultural credit guarantee system with financial capital injection leverages financial capital’s guiding role, channeling more credit resources into rural financial markets to effectively alleviate financing difficulties for agricultural operators and meet financial support requirements for the agricultural industry. Zhang Hongwu (2018) emphasizes the need to give full play to the National Agricultural Guarantee Company’s leading and supporting role, promote agricultural guarantee system construction, and continuously enhance financial support capacity for agriculture.

4 Agricultural Guarantee Digital System

Based on blockchain and big data technology applications, the agricultural guarantee digital system platform has been designed and developed to digitize the entire agricultural guarantee business process in China. All contracts and related legal documents are signed online, including guarantee contracts, credit protection triads, maximum guarantee entrustment contracts, counter-guarantee maximum amount contracts (guarantee, mortgage, pledge), counter-guarantee contracts (guarantee, mortgage, pledge), resolution documents, loan notices, guarantee confirmation letters, etc. The platform adopts electronic signature and file encryption technologies to provide users with complete and reliable electronic signature and evidence chains.

After registration, users must complete personal real-name authentication and enterprise identity authentication. Upon authentication, an authoritative digital certificate issuing center issues digital certificates to ensure electronic signature exclusivity. Using user accounts and passwords, dynamic SMS verification, and email verification codes ensures that signature operations remain under user control exclusively. Through CA signatures from the State Authority Center, signed documents with hash fingerprints are ultimately completely signed and deposited for certification at notary offices, ensuring that any file tampering can be detected and providing rapid certification services to guarantee signature legitimacy.

The agricultural guarantee digital system platform based on blockchain and big data technology fully adopts enterprise-level system architecture design, featuring technical characteristics including openness, advancement, scalability, reliability, efficiency, correctness, security, maintainability, and ease of use. Platform functions include job portal management, online examination and approval management, customer management, project management, preliminary project acceptance management, contract management, cooperative bank man-

agement, cost management, records management, electronic contract management, reporting systems, external system integration platforms, mobile client apps, big data cockpits, and intelligent risk control systems.

5 Application of Agricultural Guarantee Digital System

Hunan Province's Agricultural Credit Financing Guarantee Co., Ltd. was reorganized and established in March 2017. The company provides financing guarantees for Hunan province's "three rural" services, including agricultural production (agriculture, forestry, and fishing), farm construction, and integrated agricultural production projects involving agricultural supplies, agricultural technology, agricultural machinery, agricultural product acquisition, storage and preservation, sales, preprocessing, and new forms of agricultural business services. The company emphasizes support for grain production, live pigs, and other important agricultural products. As the province's largest agricultural guarantee institution, it operates 14 branches covering all counties and urban areas.

The Agricultural Guarantee Digital System optimizes business approval workflows for Hunan Province's Agricultural Credit Financing Guarantee Co., Ltd., digitizing the entire guarantee business process to improve operational efficiency and management levels. The system integrates existing business system data to ensure data accuracy, establishes a data warehouse to support reporting and big data cockpits, and enables enterprise-level data analysis with real-time visualization monitoring for different roles, providing strong support for enterprise decision-making.

Hunan Province's Agricultural Credit Financing Guarantee Co., Ltd. has adopted the Agricultural Guarantee Digital System to solve financing difficulties and high costs for new agricultural operators, focusing specifically on these challenges. The system significantly contributes to promoting economic development, advancing agricultural supply-side structural reform, and boosting implementation of the "rural revitalization strategy."

6.1 Time Savings and Cost Reduction

With continuous business scale growth, manual operations would require continuously increasing human resources. The digital management platform for agricultural guarantee business automatically completes many simple, mechanical, and repetitive tasks such as data verification, form filling, and summary calculations, freeing personnel from heavy workloads and effectively saving human resource costs.

Digital contract management reduces travel costs for guarantee business and lowers guarantee fund thresholds, enabling more farmers to participate in and benefit from national policies.

6.2 Improved Compliance Management Capacity

Agricultural guarantee business operations have high compliance requirements. Manual service processing suffers from problems such as unclear business rules and poor information communication. The digital management platform digitizes business processes, solidifying business rules into the system to effectively improve compliance levels and prevent compliance risks.

6.3 Enhanced Business Data Management

When business data are stored as documents or paper files, statistics and consultation become inconvenient, time-consuming, and unreliable. Manual copy-paste data transfer methods are inefficient and error-prone. The guarantee business management system construction has digitized most business data, greatly improving agricultural guarantee business management levels. It enables online processing of core project business, promotes routinization and standardization of agricultural guarantee operations, further enhances risk prevention capabilities, and comprehensively improves management levels. Simultaneously, the platform provides timely and accurate data and information for high-level corporate decision-making, enhancing core competitiveness. Therefore, constructing the digital management platform for guarantee business aligns highly with company business development needs and is imperative.

References

- Hoff, K. and Stiglitz, J. E. (1990). Introduction: Imperfect Information and Rural Credit Markets. *World Bank Economic Review*, 4(3): 235-250.
- Stiglitz, J. E. and Weiss, A. (1992). Asymmetric Information in Credit Markets and Its Implications for Macro-economics. *Oxford Economic Papers*, 44(4): 694-724.
- Akerlof, G. A. (1970). The Market for “Lemons”: Quality Uncertainty and Market Mechanism. *Quarterly Journal of Economics*.
- Chan, Y. and Kanatas, G. (1985). The Role of Collateral in Loan Agreements. *Journal of Money, Credit and Banking*, 17(1): 84-95.
- Barro, R. J. (1976). The Loan Market, Collateral, and Interest Rates. *Journal of Money, Credit and Banking*, 8(4): 439-456.
- Zecchini, S. and Ventura, M. (2009). The Impact of Public Guarantees on Credit to SMEs. *Small Business Economics*, 32(2): 191-206.
- Cao Zehui, Chen Jiancheng, Zhang Anliang. (2012). Current Situation, Problems and Countermeasures of Rural Finance Development. *Macroeconomic Management*, (05): 45-46.
- Wang Zhicai, Wang Huixin. (2006). The Influence of Rural Financial Institution Reform on New Socialist Countryside Construction and Countermeasures.

Finance and Economics, (12): 34.

Zhang Jianning. (2012). Research on Restricting Factors of Rural Specialized Cooperatives Development. *Hubei Agricultural Sciences*, 51(21): 4966-4968.

Ren Le, Wang Xingyu, Zhao Hui. (2017). Theoretical Analysis and Empirical Test on Credit Availability and Optimal Credit Amount for Farmers from Agricultural Insurance Collateral Substitution Perspective. *Management Review*, 29(06): 32-42.

Liu Lin. (2018). Case Analysis of Small and Micro Enterprise Credit Line Calculation in Commercial Banks. *Shaanxi Finance and Taxation*, (11): 55-57.

Liang Hu, Luo Jianchao. (2019). Research on Supply and Demand Credit Rationing and Its Influencing Factors: An Empirical Study Based on Data from 3459 Households in Four Provinces Under Farmland Mortgage Background. *Journal of Economic and Management Research*, 40(01): 29-40.

Yuan Chunsheng. (2014). Study on the Influence of Political Association on Credit Financing of Private Enterprises. *Journal of Shanxi University (Philosophy and Social Sciences Edition)*, 37(06): 125-130.

Zhang Wei, Cen Minhua, Luo Xiangming. (2014). Research on Multidimensional Guarantee Mechanism of Agricultural Risk in China. *Rural Economy*, (02): 61-65.

Wu Wei, Liu Yonggong. (2017). Reflection on Modernity of Agricultural Risk Based on Risk Society Theory. *Journal of Anhui Agricultural Sciences*, 45(25): 231-234+249.

Zhang Yanyuan, Yuan Bin, Chen Chao. (2016). Agricultural Management Main Body, Agricultural Risk and Agricultural Insurance. *Jiangxi Social Sciences*, (02): 38-43.

Wu Yuxiang. (2012). Establish and Improve Agricultural Guarantee System to Broaden Rural Financing Channels. *China Collective Economy*, (16): 14-15.

Dong Xiaolin, Wu Changjing. (2008). Four Guarantee Models to Solve Farmer Loan Problems. *Issues in Agricultural Economy*, (09): 35-40.

Qin Hongsong. (2014). The Predicament of Rural Real Estate Mortgage System in China. *Economic Research Reference*, (12): 24.

Zhao Jintang, Zhang Geian, Liang Yi. (2011). On Financial Support for Agricultural Credit Guarantee System—A Case Study of Gansu Province. *Journal of Lanzhou University (Social Sciences Edition)*, 39(04): 109-114.

Li Mingxing, Shu Xingyuan. (2019). Investigation and Reflection on Perfecting Policy Agricultural Credit Guarantee Service. *Contemporary Rural Finance and Economics*, (11): 59-63.

Qiao Zhen. (2013). Research on Rural Credit Guarantee Under New Countryside Construction. Central South University of Forestry and Technology.

Zhao Xuejun. (2014). The Change of Credit Guarantee System and the Predicament of Peasant Household Financing—Also Discussing the Priority of Guarantee System Construction in Rural Financial System. *Chinese Economic History Research*, (04): 129-140.

Xiao Zongfu, Bao Dahui, Wang Hongbin, Wu Jie. (2007). Incentive Mechanism and Innovation Path: A Case Study of Agricultural Guarantee Companies. *Finance Theory and Practice*, (02): 33-35.

Lin Yifu. (2001). Financial System, Credit and SME Financing. *Zhejiang Social Sciences*, (06): 9-11.

Li Zhijun. (2010). Application of Credit Default Swap in Domestic SME Loans. *Friends of Accounting (Next Issue)*, (01): 54-55.

Ji Qiongliang, Yi Shijia. (2012). Preliminary Study on Financing Insurance Mechanism of Small and Micro Enterprises. *Wuhan Finance*, (01): 64-65.

Ma Jiujiu, Luo Xing, Wang Hainan. (2016). The Construction of Agricultural Credit Guarantee System Needs Institutional Innovation. *China Rural Finance*, (22): 12-13.

Zhang Hongwu. (2018). Leveraging Policy-based Agricultural Guarantees to Boost Rural Revitalization Strategy Implementation. *Contemporary Rural Finance and Economics*, (07): 2-8.

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