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Relationship of Arable Land Scale and High-Quality Development of Farmers' Cooperatives: Evidence from Grain Production Cooperatives in China

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Abstract: Sustainable agricultural development relies significantly on the high-quality progression of farmers' cooperatives. While growing in number, farmers' cooperatives are still facing the dilemma of improving the quality of their development. Land endowment is the foundation of agricultural production and the farmers' cooperatives. Clarifying the correlation between arable land scale and the high-quality development of farmers' cooperatives is conducive to the optimization of land use and the adoption of scientific land management measures to improve the quality of the development of farmers' cooperatives. Based on the micro-survey data of 448 farmers' cooperatives in three major grain-producing provinces, namely Heilongjiang, Henan, and Shandong in China, this paper constructs an evaluation index system for the high-quality development of farmers' cooperatives and theoretically and empirically explores the impact mechanism of arable land scale on the high-quality development of farmers' cooperatives. The results suggest the following: (1) there exists a significant "inverted U-shaped" association between the arable land scale and the development quality of cooperatives, and this result remains robust after testing through substitution variable and instrumental variable methods; (2) further research on the "inverted U-shaped" association reveals that the impact of arable land scale on the high-quality development of cooperatives undergoes four stages: "weak impact—rapid improvement—diminished growth effect—decline in development quality"; and (3) mechanism tests suggest that the "inverted U-shaped" association between the arable land scale and the development quality of cooperatives is mainly constrained by industrial development input, and arable land scale and industrial development show a strong complementary relationship. Therefore, in the course of enhancing the quality of farmers' cooperatives, it is crucial to select appropriate land management strategies based on to their stage, paying special attention to the compatibility between arable land scale and industrial development.

Keywords: arable land scale; high-quality development; farmers' cooperatives; agricultural industry

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1. Introduction

According to data from COPAC (The Committee for the Promotion and Advancement of Cooperatives), approximately 800 million people worldwide are employed in cooperatives, accounting for about 10% of the global workforce. This statistic underscores the significance of cooperatives as a crucial organizational form. The Rochdale Cooperative, established in Manchester, UK, in 1844, is widely recognized as the world's first successful cooperative. Its values of openness, integrity, and respect for members continue to be fundamental principles endorsed by the International Cooperative Alliance [1]. Examining the historical development of cooperatives, Europe stands as their place of origin, with the United States and Japan subsequently adopting this organizational form. Develop-

ing countries, such as China and Brazil, gradually witnessed the formation of large-scale cooperatives several decades later [2].

Over the past century, agricultural cooperatives in various countries have developed distinctive characteristics. In several European countries, cooperatives hold a market share exceeding half, primarily concentrated in dairy, fruit, and vegetable cooperatives [3]. Cooperatives in the United States often involve corporate investments and rely on large family farms, forming integrated agricultural organizations encompassing production, processing, and sales [4]. Japan, on the other hand, has established agricultural associations top–down through the central government, characterized by a high degree of centralization and management [5]. In contrast, cooperatives in developing countries like China and Brazil are primarily composed of farmer members, tend to be smaller in scale, exhibit lower levels of industrial development, and focus on the production of staple crops [6,7]. However, regardless of the country, cooperatives share the eternal goals of enhancing cooperative efficiency, increasing product quality, and achieving sustainable, high-quality development.

In 1987, the World Commission on Environment and Development introduced the concept of sustainable development, defining it as "the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs". Scholars gradually recognized that sustainable economic development must consider certain factors, such as culture, society, and the environment [8,9]. The study of development issues in economics began to shift from simply pursuing the quantity of economic growth to focusing on the quality of economic growth [10]. In 2017, the Chinese government put forward the concept of high-quality development based on sustainable development, the core objective of which is to satisfy the people's growing needs for a better life [11]. Promoting high-quality development cannot overlook the agricultural sector, and the enhancement of the development of the quality of farmers' cooperatives emerges as a crucial topic given their significant role as key players in agricultural operations.

The high-quality development of farmers' cooperatives is built on sustainable economic growth [12], utilizing innovative and environmentally friendly production methods [13,14], adhering to cooperative principles [15], and fostering development that aligns with the shared interests of producers and consumers [16]. The connotations of high-quality development for farmers' cooperatives are extensive, and merely measuring their development based on economic performance is inadequate [17]. As agricultural organizations with broad farmer participation, the development status of farmers' cooperatives requires consideration not only of farmers' economic income and living needs but also of consumers' expectations regarding the quality of agricultural products [11]. To comprehensively assess the development quality of farmers' cooperatives and strategically promote their enhancement, it is essential to construct a comprehensive evaluation indicator system for high-quality development. This will facilitate further research into the factors influencing the development of farmer cooperatives.

Land has consistently played a crucial role in the agricultural development process, significantly impacting economic growth, environmental protection, and the formation of rural community relations [18]. Numerous studies indicate that differences in arable land scale are a major factor restricting the market competitiveness of agricultural entities [19,20]. There are generally two perspectives on the impact of arable land scale on cooperative development. First is the resource constraint view, which posits that the scarcity of arable land resources is one of the limiting factors for cooperative development. In comparison with farmers' cooperatives in developed countries, a prominent characteristic of farmers' cooperatives in developing countries is relatively smaller scale [21,22]. The small scale hinders the production and service capabilities of cooperatives while also limiting their ability to assume more social responsibilities [23]. With the development of rural revitalization and agricultural modernization, large-scale production of arable land in rural areas has become the mainstream trend in current agricultural production, and farmers' cooperatives are essential entities in the large-scale management of arable land [24–26]. Therefore, many

developing countries have implemented policies encouraging cooperatives to expand their scale. During the rapid development stage of cooperatives in developing countries, expanding operational scale is often the primary development approach.

However, another perspective is the resource curse, which suggests that an excess of arable land resources can also impact cooperative development. Continuously expanding scale is an inefficient cooperative model that leads to a collective decision-making dilemma for cooperatives. Larger operational scales can also result in uneven resource allocation and increased environmental pollution [27,28]. Studies indicate that large-scale cultivation by cooperatives has led to serious pesticide abuse and a decline in the quality of agricultural products [29], making it challenging to meet consumer market demands. For groups composed of farmers, blindly expanding scale also exposes issues of insufficient management capability [30]. Existing studies suggest that the economic growth of cooperatives primarily comes from the added value and precision management of agricultural products [31]. This is because consumer demands for the quality of agricultural products are increasing, leading to higher expectations for the quality of arable land cultivation [32]. Furthermore, cases of farms' technical efficiency from Hungary and Ecuador illustrate that the spatial potential for increasing productivity by expanding land scale is limited unless there is a change in technology [33,34]. In sub-Saharan African countries, medium-sized farms are more prevalent than large-scale farms [35].

Both of the above perspectives emphasize the decisive impact of arable land on organizational development. However, with technological advancements and changes in market demands, agricultural production has shifted from singular production of agricultural products to integrated development encompassing production, processing, and sales [36]. This shift has resulted in a transformation of the role of arable land in agricultural production. With the maturity of agricultural processing technologies and the development of rural e-commerce, the income growth of cooperatives is no longer reliant on expanding scale [37], leading to a continuous reduction in the dependence on arable land. So, in the context of the high-quality development of farmers' cooperatives, does the determinant role of arable land resources still exist? Is arable land still a foundational element influencing the high-quality development of farmers' cooperatives? Moreover, what are the characteristics of arable land's influence on the high-quality development of cooperatives? What factors constrain this influence? This paper aims to provide answers to these questions.

In contrast to prior research, this paper's marginal contributions are as follows. Firstly, based on micro-level data from major grain-producing provinces in China, this paper assesses the impact of arable land on the high-quality development of cooperatives from a cross-sectional perspective, enriching the analytical framework of arable land's impact on the high-quality development of cooperatives. Secondly, it constructs a more comprehensive indicator system to measure the high-quality development of farmers' cooperatives, broadening the analytical framework for evaluating the development level of cooperatives. Finally, it analyzes the characteristics of arable land's impact on the high-quality development of farmers' cooperatives at different stages and delves into the underlying reasons for the influence of land endowment on the high-quality development of cooperatives. Building upon the above analysis, this paper lays out theoretical and practical foundations to facilitate the government's efforts in fostering the advancement of high-quality development within farmers' cooperatives.

The remaining sections of this paper are organized as follows. Section 2 elucidates the theoretical basis of how arable land impacts the high-quality development of cooperatives. Section 3 presents the methodology, including empirical procedures, research scope, data collection, considered variables, and analysis procedures. Section 4 provides a detailed overview of the empirical results of the study. Section 5 concludes the paper and offers policy insights.

2. Theoretical Analysis

Based on the theory of economies of scale, there exists a close relationship between arable land scale and the high-quality development of cooperatives. The theory of economies of scale emphasizes that with the expansion of production scale, the average cost per unit product gradually decreases. In the agricultural sector, large-scale agricultural production can better utilize modern agricultural technology and improve land utilization efficiency, thus reducing production costs [38,39]. For farmers' cooperatives, the expansion of arable land scale implies that cooperatives can implement more detailed division of labor, which is conductive to reducing average costs and increasing profit levels, leading to an enhancement in the quality of development.

On the one hand, cooperatives with larger arable land scale can better integrate resources and enhance organizational and managerial capabilities [40,41]. By expanding arable land scale, cooperatives can achieve better economies of scale in agricultural production, procurement, and sales. Larger cooperatives are better equipped to organize members' production activities, coordinate the procurement and sales of agricultural products, and respond more flexibly to market fluctuations [42]. Simultaneously, cooperatives with a larger arable land scale often possess more comprehensive management teams, enabling them to plan and organize agricultural production more professionally [43,44]. The professionalism and efficiency in management can also lead to more refined production and operations, assisting cooperatives in better adapting to market demands and changes and promoting the green transformation of agriculture [45]. This efficient organizational and management level contributes to enhancing the overall efficiency of the cooperative, laying the foundation for its high-quality development.

On the other hand, cooperatives with a greater arable land size can reduce transaction costs, thereby enhancing synergy among members. In agricultural production, various cooperative and coordinated activities, including resource integration, production coordination, and product sales, are involved [46]. Cooperatives with a larger arable land scale have stronger negotiation power and market bargaining capabilities, allowing them to collaborate more effectively with various stakeholders in the agricultural value chain. This reduces information asymmetry and lowers transaction costs for cooperation [47]. This enables members to fully share the overall benefits of the cooperative, fostering a closer sense of community and synergistic effects [48]. Cooperation and coordination among members will be smoother, propelling the cooperative towards high-quality development.

In summary, the larger the arable land scale, the more likely it is for the cooperative to achieve high-quality development, thereby enhancing overall competitiveness and sustainable growth. Based on this, Hypothesis 1 is proposed.

Hypothesis 1. *The arable land scale has a markedly positive impact on the development quality of farmers' cooperatives. The larger the arable land scale, the higher the development quality of farmers' cooperatives.*

With the trend of rural arable land scale becoming the mainstream in current agricultural production, cooperatives also exhibit distinct characteristics in the variation of arable land scale. When exploring the impact of arable land scale on the high-quality development of cooperatives, it is essential not only to focus on the direct impact of arable land scale on the high-quality development of cooperatives but also to consider the possibility of diminishing marginal returns resulting from the expansion of arable land scale [49–51].

Firstly, the expansion of scale leads to management and decision-making challenges. On one hand, as the size of the cooperative grows, the difficulty of management increases exponentially. Large-scale cooperatives require a more complex and efficient management system, and the improvement in management level requires corresponding time and resources. If the management level does not keep pace with the increase in scale, the cooperative faces issues, such as internal organizational disarray and delayed decision making, thereby reducing the overall level of high-quality development [11]. On the

other hand, blindly expanding scale can lead to a collective decision-making dilemma for the cooperative. In a large organization, the transmission of decisions becomes slow and cumbersome, posing challenges for the cooperative in adapting to market changes and formulating flexible decisions [52]. Excessive scale can weaken the flexibility and adaptability of the cooperative, thereby reducing its agility in market competition.

Secondly, uneven distribution of resources is also a potential issue. Large-scale cooperatives concentrate more resources on core operations, leading to an uneven distribution of resources in terms of the interests and needs of some grassroots members [53]. This can result in dissatisfaction among members and the estrangement of cooperative relationships, impacting the formation of synergistic effects.

Additionally, environmental issues are also aspects that need consideration. Large-scale agricultural production triggers more environmental pollution issues, including soil contamination, excessive water resource utilization, and the misuse of fertilizers and pesticides [54]. These issues not only impose a burden on the environment but also have negative impacts on the quality and safety of agricultural products, subsequently affecting the reputation and sustainable development of the cooperative in the market. Drawing from the above arguments, this paper posits Hypothesis 2.

Hypothesis 2. *There is an "inverted U-shaped" non-linear association between arable land scale and the development quality of cooperatives. As the arable land scale increases, the development quality of farmers' cooperatives initially improves and then declines.*

Existing studies have indicated that the expansion of arable land scale, especially the fragmentation of plots, is a significant factor leading to the enlargement of marginal costs and a decline in development quality [55]. Additionally, with the maturity of agricultural processing technologies and the development of rural e-commerce, the improvement in the development quality of cooperatives comes from the value addition and refined management of agricultural products rather than blindly pursuing the expansion of arable land scale. When cooperatives have a certain arable land scale, they typically allocate funds for investment in industrial development [56]. At this point, the income growth of cooperatives no longer solely depends on the expansion of arable land scale but relies on agricultural industrialization development [57]. According to David Ricardo's perspective, when additional units of variable inputs, such as labor or land, are employed with fixed inputs, like capital or technology, the marginal productivity of the variable input will eventually diminish. In the context of agricultural cooperatives, this implies that while enlarging the scale of arable land may initially boost productivity and reduce average costs, there will eventually be a point where further expansion leads to diminishing returns, thus limiting the extent to which economies of scale can be realized.

To illustrate the changes in the development quality of cooperatives, this paper has designed a simple Cooperative Profit Model. Assuming other input factors remain constant and if the configuration of input factors does not affect input prices (i.e., land rent and equipment costs), only arable land area and industrial equipment investment are considered. Among these, arable land area is a continuously variable factor, while industrial equipment investment is a long-term input factor for cooperatives, which remains constant in the short term and is considered a non-continuous factor.

$$\pi = PA^{\alpha}K^{\beta} - wA - rK \tag{1}$$

π represents the total profit of the cooperative, P is the price of agricultural products, A and K represent the quantities of inputs of arable land and industrial equipment, respectively, α and β are the output elasticities of arable land and industrial equipment, and $\alpha + \beta = 1$, w, and r are the land rent and equipment costs. According to Equation (1), the first-order

conditions for the marginal returns of arable land and industrial equipment, respectively, can be derived:

$$\frac{\partial \pi}{\partial A} = \alpha P A^{\alpha-1} K^{\beta} - w = 0 \tag{2}$$

$$\frac{\partial \pi}{\partial K} = \beta P A^{\alpha} K^{\beta-1} - r = 0 \tag{3}$$

Based on Equations (2) and (3), the marginal output of arable land and industrial equipment can be further derived:

$$MPRA = \alpha P A^{\alpha-1} K^{\beta} = w \tag{4}$$

$$MPRK = \beta P A^{\alpha} K^{\beta-1} = r \tag{5}$$

From Equations (4) and (5), it can be observed that at profit maximization, the marginal output of arable land and industrial equipment equals their respective costs (i.e., the marginal output of arable land equals the unit cost of arable land, and the marginal output of industrial equipment equals the unit cost of industrial equipment). In this scenario, to determine the changes in cooperative profits, it is necessary to identify the cost inputs of arable land and industrial equipment, further considering the budget constraint l faced by the cooperative.

$$wA + rK \leq l \tag{6}$$

To provide a more intuitive analysis of how cooperatives maximize output under budget constraints, we can adopt the approach of equilibrium diagrams.

In the equilibrium configuration diagram of arable land area and industrial equipment investment (Figure 1), the vertical axis A represents the arable land area, and the horizontal axis K represents industrial equipment investment. Contour lines π_1, π_2, π_3, and π_4 represent different profit levels for the cooperative, where profit level $\pi_2 > \pi_3 > \pi_1 > \pi_4$. Moreover, on the same contour line of profit level, different combinations of arable land area and industrial equipment can enable the cooperative to achieve the same profit. Additionally, due to the complementary relationship between arable land area and industrial equipment investment, the initial budget constraint line l_1 is perpendicular to the 45-degree line. When industrial equipment investment is K_1, the optimal configuration is achieved with arable land area input A_1, and the equilibrium point is M_1, located on the 45° line.

According to Figure 1a, it can be observed that in consideration of long-term input expansion, the cooperative's budget constraint line shifts to l_2, resulting in a new profit-maximizing intersection at M_2. At this point, the arable land input is A_2, and the industrial equipment input is K_2. Due to the complementary relationship between arable land and industrial equipment, the cooperative can process all output from the arable land, leading to all profits being value-added profits.

However, when considering short-term input variations for the cooperative, according to Figure 1b, the industrial equipment input remains unchanged in the short term, as the capital required for industrial equipment input exceeds the increase in arable land scale. Consequently, as the relative price of arable land decreases for the cooperative, the budget constraint line shifts to l_3. At this juncture, the profit-maximizing intersection becomes M_3, surpassing the processing capacity of industrial equipment A_1. As a result, the produced agricultural products cannot all be processed and sold. The shaded portion of agricultural products must be sold at a lower market price, thereby reducing the cooperative's profit.

Additionally, considering the scenario where the cooperative reduces its inputs, according to Figure 1c, the budget constraint line shifts leftward to l_4. At this point, the cooperative's arable land area input to A_4, the processing capacity of the cooperative's industrial equipment, remains unchanged. The intersection point M_4 satisfies profit maximization. However, due to the small output of agricultural products, it cannot meet the processing needs of the industrial equipment. This leads to the underutilization of a portion of processing capacity, resulting in wastage of fixed costs for agricultural product

industrial equipment. Additionally, it increases the unit output cost, thereby resulting in the cooperative's inability to achieve optimal profit.

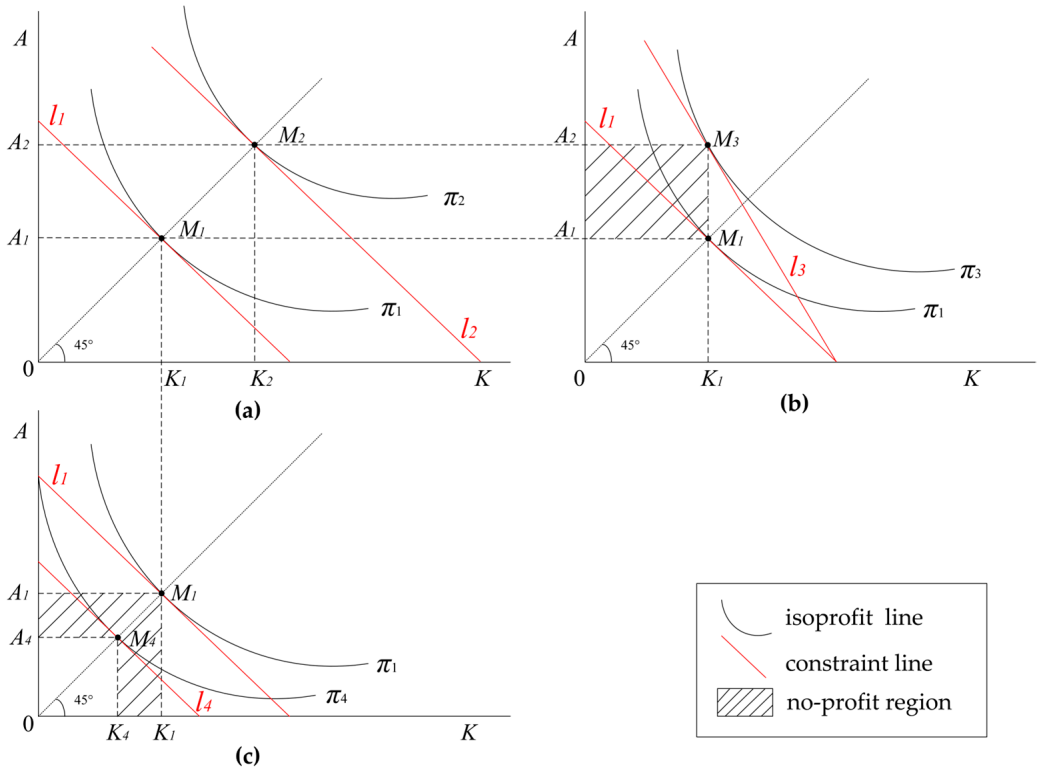

Figure 1. Equilibrium diagram of cooperatives' arable land area and industrial equipment input allocation. (**a**) Increased inputs; (**b**) Relative price changes; (**c**) Reduced inputs.

In summary, when the arable land area is too large or too small, influenced by the short-term constancy of industrial equipment investment, it will prevent the cooperative from obtaining optimal profits. Moreover, the profit level is just one evaluation criterion for the high-quality development of the cooperative. After considering certain factors, such as social benefits, green production, and standardization, the "inverted U-shaped" association between arable land scale and cooperative high-quality development becomes more pronounced. Drawing on the above arguments, this paper posits Hypothesis 3.

Hypothesis 3. *Industrial development is the key factor in the "inverted U-shaped" association between arable land and the development quality of the cooperative.*

3. Materials and Methods

3.1. Research Methods

3.1.1. Evaluation Model

The commonly used weighting methods in evaluative research include expert weighting, the analytic hierarchy process (AHP), the entropy method, and factor analysis. The first two methods rely to some extent on subjective judgment, while the latter two, though more objective, may lead to unreasonable weight assignments when dealing with unevenly distributed data. Therefore, adopting a single weighting method can easily lead to a contradiction between the weight of indicators and their actual importance. Therefore, many scholars in existing evaluative research have employed a combination weighting method, achieving favorable results [58,59]. On one hand, combining weighting methods reduces the subjective bias generated during expert judgment. On the other hand, it helps avoid the objective bias caused by differences in data quality. Therefore, this paper ultimately adopts a combination of the analytic hierarchy process and entropy method. It utilizes

the comprehensive weights calculated by these two methods to measure the development quality of farmers' cooperatives.

1. Analytic hierarchy process (AHP). Firstly, based on the evaluation indicator system for the high-quality development of farmers' cooperatives, construct a hierarchical structure model with four levels. Secondly, experts score the matrix using a 1~9 scale and calculate the weights. Finally, obtain consistency test results by calculating the characteristic roots, eigenvector values, and the corresponding average random consistency index (RI). After passing the consistency test, AHP indicator weights can be obtained.
2. Entropy method. Considering the different attributes, units, and ranges of the evaluation indicators, the data are first standardized. Secondly, compute the information entropy and information utility values of each indicator using the standardized data. Finally, after normalization, obtain the entropy method weights for each evaluation indicator.

$$e_j = -\frac{1}{\ln n}\sum_{i=1}^{n}\frac{X'_{ij}}{\sum_{i=1}^{n}X'_{ij}}\ln\frac{X'_{ij}}{\sum_{i=1}^{n}X'_{ij}} \tag{7}$$

$$d_j = 1 - e_j \tag{8}$$

$$\beta_j = d_j / \sum_{j=1}^{m} d_j \tag{9}$$

e_j represents entropy, n is the number of sample cooperatives, and X'_{ij} represents the standardized values; d_j represents the coefficient of variation for the j indicator, also known as information utility or information entropy redundancy; β_j is the weight value, and m is the number of indicators.

3. Comprehensive Weight Calculation. Based on the principle of minimum relative entropy, we use the Lagrange multiplier method to compute composite weights, ensuring the accuracy and scientific validity of the weight calculation results.

The calculation formula is as follows:

$$W_f = \sqrt{\alpha_j \cdot \beta_j} / \sum_{j=1}^{m} \alpha_j \cdot \beta_j \tag{10}$$

α_j represents the analytic hierarchy process (AHP) weight result, β_j represents the entropy method weight result, and W_f is the comprehensive weight.

3.1.2. Regression Model

This paper mainly explores the linear relationship and "inverted U-shaped" association between land scale and cooperative development quality. Based on this, linear and nonlinear function models are constructed.

The calculation formula is as follows:

$$CDQ_i = \alpha + \beta ALS_i + \theta control_i + \varepsilon_i \tag{11}$$

$$CDQ_i = \alpha + \beta_1 ALS_i + \beta_2 {ALS^2}_i + \theta control_i + \varepsilon_i \tag{12}$$

The dependent variable CDQ_i represents the development quality index of cooperative i and the core explanatory variables, ALS_i and ${ALS^2}_i$, respectively, represent the land scale and its squared term for the cooperative. In addition, $control_i$ represents a series of control variables affecting the development quality of the cooperative, and ε_i represents the residual term.

3.2. Variable Definitions and Descriptions

3.2.1. Dependent Variable

The high-quality development of farmers' cooperatives is a crucial component of China's high-quality economic development. It extends traditional performance evaluations of cooperatives under the premise of sustainable development and represents a key link in the transformation of cooperatives into high-level agricultural organizations. Therefore, the high-quality development of farmers' cooperatives should encompass four dimensions. Firstly, it should be premised on the continuous creation of economic value. Secondly, it should prioritize agricultural innovation and the production of green products as means. Thirdly, it should adhere to operational and financial standards to ensure effective governance and management. Lastly, it should aim to drive the development of rural communities and farmers as its ultimate goal.

Specifically, the achievement of any single goal can contribute to the improvement of high-quality development in cooperatives. In the assessment system, a deficiency in any indicator may impact the overall development evaluation. For instance, if a cooperative solely pursues economic profit growth at the expense of environmental sustainability, the quality of its development may be questioned. Conversely, if a cooperative focuses only on sustainable product production but sacrifices operational profits, it can also affect its development quality. We aim to highlight cooperatives that prioritize sustainable development, even if it means sacrificing some profit, and actively support their communities. This is because solely using economic growth as a criterion may overlook the significant contributions of these cooperatives. However, we do not encourage neglecting cooperatives that prioritize their economic development and the interests of their members. Therefore, the best practice is to conduct a comprehensive assessment of high-quality development to thoroughly measure the performance of cooperatives.

In selecting specific indicators, we drew upon the three dimensions of the economic, social, and ecological performance evaluation system of cooperatives [7]. Additionally, we expanded these indicators to encompass aspects of innovation and standardization, aligning with the principles of high-quality development (refer to Table 1). Through the establishment of an assessment system for high-quality development, our aim is to furnish cooperatives in other countries with enhanced understanding and practical insights to attain sustainable development goals, thereby fostering global advancement and expansion of cooperative movements.

Due to the importance of indicators being dependent on their assigned weights, we employed a comprehensive evaluation method that combines both subjective and objective considerations in assigning weights. According to the results in Table 1, among the five primary indicators, the comprehensive weight for the economic foundation is the highest, indicating that the economy remains the cornerstone of high-quality development for cooperatives. Following in descending order of weights are social value, green development, standardization, and innovation capacity, reflecting the varying degrees of significance across different aspects in the process of high-quality development for cooperatives.

Table 1. Evaluation indicator system for high-quality development of farmers' cooperatives.

Primary Indicator	Comp. Wt.	Secondary Indicator	Comp. Wt.	Tertiary Indicator	AHP Wt.	Entropy Wt.	Comp. Wt.
Economic Basis (EB)	0.2622	Profitability	0.1799	Average Income per Member (CNY 10,000)	0.1489	0.0165	0.0579
				Operating Profit (CNY 10,000)	0.1489	0.0733	0.1220
		Industry Integration	0.0823	Processing Proportion (%)	0.0695	0.0128	0.0349
				New Sales Methods (%)	0.1290	0.0128	0.0474
Innovation Capability (IC)	0.1026	Technological Innovation	0.0321	Standards/Patents (pcs)	0.0147	0.0233	0.0216
				Application of Fine Seeds (%)	0.0098	0.0081	0.0104
		Cooperative Branding	0.0705	Registered Trademarks (pcs)	0.0086	0.0774	0.0301
				Brand Coverage (1~6)	0.0159	0.0751	0.0404

Table 1. *Cont.*

Primary Indicator	Comp. Wt.	Secondary Indicator	Comp. Wt.	Tertiary Indicator	AHP Wt.	Entropy Wt.	Comp. Wt.
Green Development (GD)	0.2161	Ecological Protection	0.0686	Proportion of Reduced Chemical Area (%)	0.0421	0.0638	0.0606
				Recycling Rate of Agricultural Waste (%)	0.0227	0.0021	0.0080
		Product Safety	0.1475	Quality Certification Standards (1~5)	0.0583	0.0816	0.0806
				Traceability Proportion (%)	0.0388	0.0845	0.0669
Standardization Level (SL)	0.1366	Operational Standards	0.0771	Frequency of Member Meetings/Director Meetings (times/year)	0.0158	0.0407	0.0296
				Proportion of Distributable Surplus Returned (%)	0.0369	0.0447	0.0474
		Financial Standards	0.0596	Frequency of Financial Report Disclosure (times/year)	0.0151	0.0301	0.0249
				Frequency of Accounting (times/year)	0.0280	0.0315	0.0347
Social Value (SV)	0.2825	Social Participation	0.1409	Investment in Village Collective Construction (CNY 10,000)	0.0355	0.1328	0.0802
				Number of Cooperative Enterprises/Other Cooperatives (pcs)	0.0532	0.0507	0.0607
		Training and Employment	0.1416	Number of People Trained in Farmer Training Projects (ppl)	0.0379	0.0672	0.0590
				Number of Jobs Created by the Cooperative (pcs)	0.0705	0.0710	0.0827

Note: The specific explanation of indicators, data, and the original questionnaire can be found in Appendices A–D.

3.2.2. Independent Variables

This paper takes "cooperative arable land scale" as the core explanatory variable, which includes the total area of land contributed by cooperative members and the land area acquired by the cooperative through leasing. Cooperative farm management involves three types of land. The first is land contributed by cooperative members, where members invest their land as capital in cooperative production and they receive profit dividends. The second is leased land, where the cooperative acquires land from farmers or other organizations by paying rent and then manages it uniformly. The third is land management, where the cooperative provides services for arable land owned by farmers or other organizations and only charges service fees. The land scale discussed in this paper is based on the cooperative's input and output; land management does not reflect this characteristic.

3.2.3. Control Variables

1. Characteristics of the cooperative chairman. Referring to previous research, the chairman of a farmer's cooperative, as a crucial leader of the organization, plays a significant role in the decision making for the cooperative's development. This paper controls for the chairman's gender, age, educational level, and position.
2. Basic characteristics of the cooperative. The basic characteristics of a farmers' cooperative include fixed assets, the number of members, and the external environment of the cooperative, which have fundamental effects on the development quality of the cooperative.
3. Operational and management characteristics of the cooperative. This mainly includes the operational system and advantageous resources of the cooperative.

By comprehensively considering the above variables, a more accurate analysis of the relationship between the cooperative's land scale and high-quality development can be achieved, eliminating the potential impact of other factors on the research results and enhancing the credibility and scientific rigor of the study. The definition and description of variables are shown in Table 2.

Table 2. Variable definition and description.

Variable Type	Variable Name	Variable Definition and Description
Dependent Variable	Cooperative Development Quality (CDQ)	Evaluated Through the Evaluation Index System for High-Quality Development of farmers' cooperatives (Table 1)
Independent Variable	Arable Land Scale (ALS)	Total Area of Land Invested by Cooperative Members and Land Leased by The Cooperative (kha)
Control Variable	Characteristics of Cooperative Chairman (CCC)	Gender (1 = Male, 0 = Female) Age (years, logarithm) Educational Level (5 = Bachelor's and above, 4 = College, 3 = High School or Technical School, 2 =Junior High School, 1 = Elementary School and below) Village Cadre (1 = Yes, 0 = No)
	Basic Characteristics of Cooperative (BCC)	Cooperative Total Assets (CNY 10,000, logarithm) Number of Cooperative Members (ppl, logarithm) Large Agricultural Machinery Quantity (units) Demonstration Level (5 = National, 4 = Provincial, 3 = Municipal, 2 = County, 1 = None) Distance to County Town (kilometers) Distance to The Nearest Formal Financial Institution (kilometers)
	Operational and Management Characteristics of Cooperative (OMCC)	Second Rebate System (1 = Yes, 0 = No) One-Person-One-Vote System (1 = Yes, 0 = No) Number of Full-time Employees (ppl) Proportion of Social Relationship Expenses to Cooperative Surplus (%)

3.3. Data Sources

The data for this study were obtained via a questionnaire survey conducted from December 2022 to September 2023 in the top three grain-producing provinces in China (Heilongjiang, Henan, and Shandong), covering 14 cities and 70 counties. In the sample questionnaire survey, approximately 7 cooperatives were randomly selected in each county, with a total of 500 questionnaires distributed and 487 successfully collected, of which 448 met the research requirements, achieving an effective rate of 89.6%.

Due to significant differences in resource endowments among different types of farmers' cooperatives, it is not possible to conduct a high-quality development assessment under a single standard. Therefore, based on the core issue of this study, the final choice was to investigate production and operation-oriented cooperatives with grain production as the main business. Livestock and poultry farming cooperatives and service cooperatives are not within the scope of this study. This choice aims to ensure an in-depth investigation into the mechanism of how land scale influences the high-quality development of farmers' cooperatives while avoiding interference from differences between different types of cooperatives.

3.4. Descriptive Statistics

Table 3 presents the descriptive statistical analysis results of the data obtained in this study. Firstly, among the 448 sampled farmers' cooperatives, the average development quality of farmers' cooperatives is 0.1408, with a maximum value of 0.7670 and a minimum value of 0.0060. It can be observed that there is significant variation in the development quality among the sampled cooperatives, and, overall, the development quality of cooperatives is relatively low, which is consistent with the conclusions drawn from the literature review and on-site investigations. Secondly, the mean value of the explanatory variable, land scale, is 0.4544, with a maximum value of 5.6000 and a minimum value of 0.0191. This indicates substantial individual heterogeneity in land scale among the sampled cooperatives, implying significant differences in land scale among different cooperatives potentially

facing various management and operational challenges. Descriptive statistical analysis results for other control variables are presented below.

Table 3. Descriptive statistical analysis results of sample cooperatives.

Variable	Observations	Mean	SD	Min	Max
Cooperative Development Quality (CDQ)	448	0.1408	0.1589	0.0060	0.7670
Arable Land Scale (ALS)	448	0.4439	0.6323	0.1910	4.2
Chairman's Gender	448	0.7656	0.4241	0	1
Chairman's Age	448	3.8022	0.1643	3.3322	4.2047
Chairman's Educational Level	448	3.3527	0.7177	2	5
Chairman's Village Cadre	448	0.3013	0.4594	0	1
Cooperative Total Assets	448	4.8042	1.1102	3.3499	8.5348
Number of Cooperative Members	448	4.1358	0.9327	2.9444	6.9217
Large Agricultural Machinery Quantity	448	1.3359	0.9707	0	4.8903
Demonstration Cooperative Level	448	1.8147	1.4092	1	5
Distance to County Town	448	19.9634	8.9498	5.5	53
Distance to Financial Institutions	448	3.4196	2.7343	0.5	20
Second Rebate System	448	0.0759	0.2651	0	1
One-Person-One-Vote System	448	0.1272	0.3336	0	1
Number of Full-time Employees	448	1.8585	1.3420	0	5.1985
Proportion Social Relationship Expenses	448	0.6775	1.4832	0	10

Note: The data in the table are organized based on the content of on-site investigations.

4. Results

4.1. Empirical Results

4.1.1. Inverted U-Shaped Relationship

Table 4 analyzes the impact of arable land scale on cooperative development quality (CDQ). From Model 1-1 to Model 1-4, the core explanatory variable land scale (ALS), land scale squared term (ALS^2), and other control variables are gradually introduced. The results show that land scale has a significant impact on the development quality of cooperatives in all models, with positive coefficients. This indicates that, on average, as the land scale operated by cooperatives increases, the development quality of cooperatives also increases. This conclusion verifies H1 stated earlier and is consistent with conclusions drawn from existing research.

It is worth noting this when considering the nonlinear relationship between land scale and the development quality of cooperatives. In Model 1-2 and Model 1-4, the regression coefficients of the land scale squared term are -0.067 and -0.031, with p-values less than 0.01, indicating a significant "inverted U-shaped" association. This implies that as the land scale expands, the rate of improvement in the development quality of cooperatives gradually slows down. There is also a threshold effect, where beyond a certain critical point, the expansion of land scale may lead to a decrease in the development quality of cooperatives. This result validates H2 mentioned earlier.

Table 4. Arable land scale and cooperative development quality.

Variable	Model 1-1	Model 1-2	Model 1-3	Model 1-4
Arable Land Scale (ALS)	0.197 *** (0.006)	0.409 *** (0.009)	0.054 *** (0.006)	0.201 *** (0.013)
Square of Arable Land Scale (ALS^2)		−0.067 *** (0.002)		−0.031 *** (0.003)
Chairman's Gender			−0.006 (0.006)	−0.005 (0.005)
Chairman's Age			−0.028 * (0.016)	−0.014 (0.014)
Chairman's Educational Level			0.006 (0.004)	0.005 (0.003)
Chairman's Village Cadre			0.013 ** (0.005)	0.011 ** (0.004)
Cooperative Total Assets			−0.024 *** (0.005)	−0.021 *** (0.004)
Number of Cooperative Members			0.023 *** (0.006)	0.021 *** (0.005)
Large Agricultural Machinery Quantity			0.014 *** (0.004)	0.003 (0.003)
Demonstration Cooperative Level			0.015 *** (0.003)	0.010 *** (0.003)
Distance to County Town			0.001 *** (0.000)	0.001 *** (0.000)
Distance to Financial Institutions			−0.003 ** (0.001)	−0.001 (0.001)
Second Rebate System			0.032 *** (0.012)	0.023 ** (0.010)
One-Person-One-Vote System			−0.017 (0.011)	−0.010 (0.010)
Number of Full-time Employees			0.026 *** (0.004)	0.016 *** (0.003)
Proportion Social Relationship Expenses			0.049 *** (0.003)	0.036 *** (0.003)
Constant	0.051 *** (0.005)	−0.067 (0.004)	0.084 (0.066)	0.032 (0.057)
Sample Size	448	448	448	448
Adjusted R^2	0.703	0.889	0.927	0.945

Note: *** indicates $p < 0.01$, ** indicates $p < 0.05$, * indicates $p < 0.1$; values in parentheses are standard errors, etc.

4.1.2. Categorized Cooperative Development Quality

Cooperative development quality is a comprehensive indicator. To further explore the relationship between ALS and the categorized development quality of cooperatives, this study conducted tests using five models, with EB, IC, GD, SL, and SV as the dependent variables. The results indicate that there is a significant "inverted U-shaped" association between ALS and the development quality of cooperatives in all categorized models, consistent with the overall development quality results. This implies that with the expansion of ALS, the quality in each category follows the pattern of first increasing and then decreasing.

Specifically, the impact of changes in ALS on the categorized development quality of cooperatives is as follows: GD > SV > EB > IC > SL. Among them, the impact of ALS on GD is the most significant. This indicates that with the expansion of cooperative ALS, it is more likely to cause environmental issues, requiring the formulation of more reasonable strategies for green development to ensure environmental sustainability. Changes in ES and SV are also relatively pronounced, indicating that in the process of expanding ALS, cooperatives may face issues, such as declining profits and neglecting social responsibilities. Therefore, cooperatives need to focus on maintaining economic stability, enhancing social responsibility, and caring for community development. The impact of ALS on IC and SL is relatively small, indicating that these two aspects are relatively stable and less affected by changes in scale.

Overall, with the expansion of ALS, the categorized development quality of cooperatives exhibits a significant "inverted U-shaped" association. However, the impact of ALS on the development quality of different cooperative classifications varies. Therefore, when cooperatives pursue high-quality development, it is necessary to consider the development quality of different classifications. The management of ALS needs to comprehensively consider various influences to balance economic benefits, social responsibility, and environmental sustainability (Table 5).

Table 5. Arable land scale for grain crops and categorized development quality of cooperatives.

Variable	EB	IC	GD	SL	SV
	Model 2-1	**Model 2-2**	**Model 2-3**	**Model 2-4**	**Model 2-5**
ALS	0.035 ***	0.032 ***	0.065 ***	0.025 ***	0.044 ***
	(0.005)	(0.002)	(0.006)	(0.003)	(0.004)
ALS^2	−0.008 ***	−0.005 ***	−0.010 ***	−0.004 ***	−0.005 ***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
CCC	Control	Control	Control	Control	Control
BCC	Control	Control	Control	Control	Control
OMCC	Control	Control	Control	Control	Control
Sample Size	448	448	448	448	448
Adjusted R^2	0.862	0.912	0.856	0.892	0.904

Note: *** indicates $p < 0.01$. "Control" indicates variables that have been controlled, etc.

4.2. Robustness Tests

4.2.1. Estimation Results with Replacement of Independent Variables

In the process of exploring the impact of ALS on CDQ, this paper uses the total area of cooperative ALS as the core explanatory variable. To further validate the robustness of the regression results mentioned earlier, this paper divides the total area of ALS into two categories, invested arable land and transferred arable land, and conducts a regression analysis again. Similarly, the models control for CCC, BCC, and OMCC. The regression results in Table 6 are consistent with the previous findings, indicating the robustness of the research conclusions.

According to Models 3-1 and 3-2, it can be observed that whether it is invested arable land or transferred arable land, with the expansion of ALS, the development quality of cooperatives shows an increasing trend. However, the impact of the area of invested arable land on development quality is significantly greater than that of transferred land. One important reason is that land transfer requires priority payment of rent and is not conducive to the long-term arable land infrastructure construction of cooperatives, thereby restricting the high-quality development of cooperatives to a certain extent.

Table 6. The impact of varied sources of arable land scale on cooperative development quality.

Variable	Model 3-1	Model 3-2	Model 3-3	Model 3-4
ALS (invested)	0.328 *** (0.020)		0.708 *** (0.033)	
ALS (transferred)		0.041 *** (0.007)		0.106 *** (0.015)
ALS^2 (invested)			−0.297 *** (0.022)	
ALS^2 (transferred)				−0.019 *** (0.004)
CCC	Control	Control	Control	Control
BCC	Control	Control	Control	Control
OMCC	Control	Control	Control	Control
Sample Size	448	448	448	448
Adjusted R^2	0.946	0.920	0.962	0.924

Note: *** indicates $p < 0.01$.

Furthermore, the results from Models 3-3 and 3-4, with the introduction of squared terms, indicate a significant "inverted U-shaped" association for both invested arable land and transferred arable land. This suggests that both land investment and transfer need to be controlled within a certain scale, as exceeding a critical point will lead to a decline in development quality. Therefore, cooperatives need to balance the expansion of scale with the improvement of development quality in arable land management, thus preventing the negative impact of excessive scale expansion.

4.2.2. Estimation Results after Addressing Endogeneity Issues

Although this paper thoroughly discusses the regression results of different explanatory variables and the explained variable in the preceding sections, arriving at consistent conclusions, there may still be endogeneity issues in the process of econometric regression, primarily in the following aspects. First, there might be a problem of reverse causality. The more superior the development quality of farmers' cooperatives, the more extensive the demand for arable land, and the more robust the capacity to expand ALS. Second, there is an issue of measurement errors. Although the questionnaire was corrected through pre-survey before the investigation and the interviewers were trained, to adhere to the principle of random sampling, the sample cooperatives were relatively dispersed, and some questionnaires were conducted via telephone interviews, leading to potential measurement errors. Third, there is a problem of omitted variables. To avoid potential endogeneity issues arising from the omission of important variables, this paper, referring to the existing literature and considering practical data acquisition, selected control variables from three aspects, characteristics of cooperative chairpersons, basic features of cooperatives, and operational and managerial features of cooperatives, possibly neglecting factors from other aspects. Therefore, to address the potential endogeneity issues mentioned above, this paper adopts the Two-Stage Least Squares (2SLS) method for instrumental variable regression.

The instrumental variable selected in this paper is "Average Household Arable Land (IV1)", which represents the ratio of the arable land area owned by cooperative members to the total number of members. The reasons for choosing this instrumental variable are twofold. Firstly, the Average Household Arable Land in cooperative societies is not directly related to the quality of cooperative development. However, generally, the larger the per capita arable land area, the more extensive the ALS that cooperatives can acquire through members' equity participation or land transfer. Therefore, Average Household Arable Land can indirectly influence cooperative development quality by directly affecting the cooperative ALS. Secondly, the Average Household Arable Land is determined by land tenure rights and remains constant over the long term, and the sample survey point in this paper is the year 2022. Therefore, the instrumental variable is not significantly correlated with other control variables for that year. Combining these two reasons, the paper considers the selection of "Average Household Arable Land" as an appropriate instrumental variable. Next, regression and testing of the instrumental variable will be conducted. Considering that this paper's core explanatory variables consist of two variables, ALS and ALS^2, in the empirical test, the "Square of Average Household Arable Land (IV2)" is additionally included as the second instrumental variable.

Table 7 displays the regression outcomes of the instrumental variable. Models 4-1 and 4-2 present the test results of the correlation between the instrumental variable and the ALS along with ALS^2, and both model results are significant. Model 4-3 displays the test results of the ALS and ALS^2 on CDQ after applying the instrumental variable. The signs of model coefficients and statistical significance are consistent with the regression results mentioned earlier, further supporting the theoretical assumptions of the study. The instrumental variable test results indicate that the absolute values of the coefficients of key explanatory variables in the regression equation are larger than those in the baseline regression model (Model 1-4). This aligns with the convention of instrumental variable regression results. The R-squared of this model is 0.936, indicating a relatively high level of model fit.

Furthermore, using a 10% deviation as the maximum range criterion for the instrumental variable [60], the study's results show that the minimum eigenvalue statistic is significantly greater than the critical value within the 10% deviation range of the instrumental variable. Therefore, there is no issue of weak instrumental variables.

Finally, based on the results of the Durbin–Wu–Hausman test (DWH test), it indicates the presence of certain endogeneity issues in the model. Therefore, the estimates based on the instrumental variable (Model 4-3) should be considered, and it still concludes a significant "inverted U-shaped" impact of land scale on the development quality of cooperatives.

Table 7. Instrumental variable test regression results.

Variable	ALS	ALS^2	CDQ
	Model 4-1	**Model 4-2**	**Model 4-3**
IV1	0.255 *** (0.061)		
IV2		1.449 *** (0.204)	
ALS			0.320 *** (0.030)
ALS^2			−0.055 *** (0.010)
CCC	Control	Control	Control
BCC	Control	Control	Control
OMCC	Control	Control	Control
Minimum Eigenvalue Statistic			100.718
DWH Test			13.191 ***
Sample Size	448	448	448
R^2	0.974	0.908	0.936

Note: *** indicates $p < 0.01$.

4.3. Mechanism Analysis

4.3.1. Stage-Specific Characteristics

According to the analysis in the previous sections, the impact of ALS on the CDQ exhibits an "inverted U-shaped" pattern. Based on existing research findings, fitting a scatter plot to assess the "inverted U-shaped" relationship is considered an effective method [61]. According to the distribution of ALS and the CDQ shown in Figure 2, the impact of ALS on the CDQ can be divided into four main stages. (1) Initial Impact Stage (ALS 0–0.4 kha): At this point, cooperatives have a relatively small land scale. Although expanding the land scale would enhance development quality, the impact is relatively weak. (2) Rapid Improvement Stage (ALS 0.4–0.8 kha): Once cooperatives achieve a certain land scale, further expansion rapidly improves the development quality of the cooperative. (3) Diminishing Growth Effect Stage (ALS 0.8–1.2 kha): When the land scale exceeds a certain threshold, the rate of improving development quality through expanding the land scale significantly slows down. (4) Declining Development Quality Stage (ALS above 1.2 kha): When the cooperative's land scale reaches a threshold where development quality starts to decline, continuous expansion of the land scale leads to a decrease in development quality.

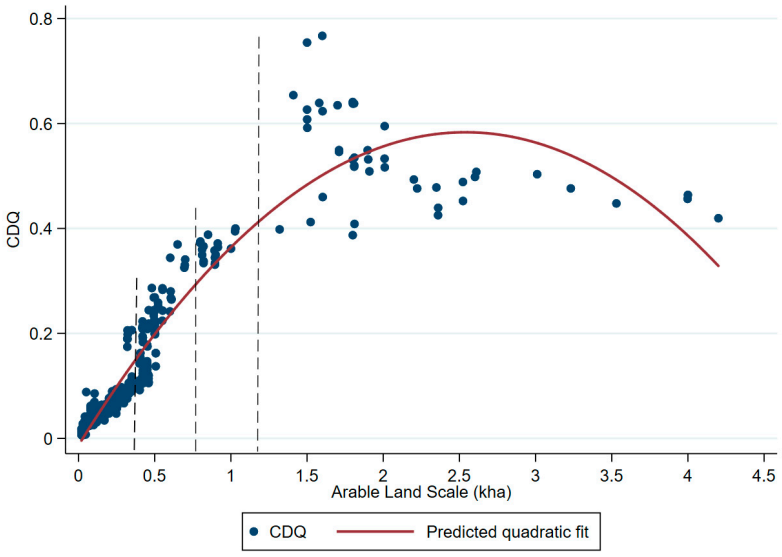

Figure 2. Scatter plot of ALS and CDQ distribution.

According to the regression results in Table 8, it is evident that in Models 5-1 to 5-3, the coefficient of ALS on the CDQ undergoes an initial increase followed by a decrease. However, during this stage, the coefficient value remains positive. In Model 5-4, when the ALS exceeds 1.2 kha, the impact of ALS on the CDQ becomes significantly negative. This indicates that it has entered the fourth stage of development, where further increases in land scale led to a decline in the CDQ. It is important to note that the delineated turning points for land scale represent statistical patterns observed in the sampled cooperative societies and may vary in reality regarding the turning points between ALS and CDQ.

Table 8. Revised regression results by segments.

Variable	0–0.4 kha	0.4–0.8 kha	0.8–1.2 kha	1.2+ kha
	Model 5-1	Model 5-2	Model 5-3	Model 5-4
ALS	0.257 ***	0.561 ***	0.284 ***	−0.056 ***
	(0.012)	(0.065)	(0.059)	(0.015)
CCC	Control	Control	Control	Control
BCC	Control	Control	Control	Control
OMCC	Control	Control	Control	Control
Sample Size	296	90	18	44
Adjusted R^2	0.801	0.798	0.743	0.431

Note: *** indicates $p < 0.01$.

4.3.2. Arable Land Fragmentation and Cooperative Industrialization

After clarifying the four-stage characteristics of how ALS influences the high-quality development of cooperatives, this paper focuses on the reasons behind the threshold of high-quality development in cooperatives. Based on the theoretical analysis in the previous sections, industrialization development is a key factor influencing the inverted U-shaped relationship between arable land scale and the quality of farmers' cooperatives development. Therefore, this paper adopts three methods to analyze the influence mechanism of industrialization development.

(1) Grouping cooperatives based on whether they undergo industrialization development and then separately examining the relationship between arable land scale and the quality of cooperative development within each group. If the inverted U-shaped relationship between arable land scale and cooperative development quality is more pronounced in the groups undergoing industrialization, it indirectly supports the complementary mechanism of industrialization development.

(2) Constructing a complementary function between arable land scale and industrialization development to explore the impact of this complementary function on the quality of cooperative development.

(3) Introducing a moderation effects model of industrialization development. Interacting the linear and quadratic terms of arable land scale with the indicator of industrialization development to investigate how industrialization influences the nonlinear impact of arable land scale on the quality of cooperative development.

The specific formula settings are as follows:

$$COMP_i = \frac{IDI_i - IDI_{min} / IDI_{max} - IDI_{min}}{ALS_i - ALS_{min} / ALS_{max} - ALS_{min}} \quad (13)$$

$$CDQ_i = \alpha + \beta COMP_i + \theta control_i + \varepsilon_i \quad (14)$$

$$CDQ_i = \alpha + \beta_1 ALS_i + \beta_2 ALS^2{}_i + \beta_3 IDI_i + \beta_4 ALS_i \times IDI_i + \beta_5 ALS^2{}_i \times IDI_i + \theta control_i + \varepsilon_i \quad (15)$$

$COMP_i$ represents the complementarity of the cooperative and IDI_i and ALS_i, respectively, denote the amount of investment in industrial development and the arable land scale of the cooperative. CDQ_i represents the development quality of the cooperative,

$control_i$ represents a series of control variables influencing the development quality of the cooperative, and ε_i represents the residual term.

According to the empirical results in Table 9, Model 6-1 represents cooperatives undergoing industrialization development, and its regression results are consistent with the overall findings. Model 6-2 represents cooperatives that have not undergone industrialization development. From the regression results, it can be observed that the inverted U-shaped relationship between ALS and CDQ does not hold in these cooperatives. In cooperatives without industrialization development, there is a linear correlation between ALS and CDQ. This clearly indicates that industrialization development is a crucial factor influencing the establishment of the inverted U-shaped relationship between ALS and CDQ.

Model 6-3 demonstrates the impact of COMP on CDQ, revealing a significant positive influence of COMP on the CDQ. This validates the crucial role of industrialization development discussed earlier. Only when IDI is aligned with ALS can it promote the improvement of cooperative development quality.

Table 9. The mechanism analysis of the impact of arable land scale on cooperative development quality.

Variable	Model 6-1	Model 6-2	Model 6-3	Model 6-4	Model 6-5
ALS	0.205 ***	0.167 ***		0.311 ***	0.379 ***
	(0.032)	(0.043)		(0.018)	(0.018)
ALS^2	−0.024 ***	0.322 ***		−0.041 ***	−0.070 ***
	(0.004)	(0.104)		(0.003)	(0.004)
COMP			0.118 ***		
			(0.018)		
IDI					0.023 ***
					(0.006)
ALS × IDI					−0.053 ***
					(0.018)
ALS^2 × IDI					0.014 ***
					(0.003)
CCC	Control	Control	Control	Control	Control
BCC	Control	Control	Control	Control	Control
OMCC	Control	Control	Control	Control	Control
Sample Size	133	315	448	448	448
Adjusted R^2	0.936	0.877	0.829	0.955	0.964

Note: *** indicates $p < 0.01$.

Finally, Models 6-4 and 6-5 analyze the moderating effects of industrial development. In Model 6-5, the coefficient of ALS × IDI is significantly negative, indicating that in the initial stages of smaller arable land scale, as the level of industrial development increases, the positive impact of ALS on CDQ diminishes. Possible reasons include the inability of smaller arable land scale to fully leverage the advantages brought by industrialization (such as technology, market access, etc.) or the increased costs associated with industrialization that are harder to spread over smaller arable land scale. Additionally, the coefficient of ALS2 × IDI is significantly positive, suggesting that with further expansion of ALS, the higher level of IDI intensifies the marginal positive impact of ALS on CDQ. This may indicate that at a certain level of industrialization, larger arable land scale can benefit more from industrialization, such as through economies of scale, more efficient resource utilization, and better market access.

Combining the research findings, simply pursuing an expansion of arable land scale is not always the optimal strategy in an industrialized context. Cooperatives need to identify the point where arable land scale matches the level of industrialization to achieve the best development outcomes.

5. Discussion

Cooperative development assessment is a globally discussed topic, with many scholars selecting cooperatives as their research focus, albeit with varying emphases [62,63]. Some studies primarily analyze the economic benefits of cooperatives, providing clear insight into their economic development while often neglecting other aspects [64,65]. In recent years, an increasing number of scholars have begun to emphasize comprehensive performance, advocating for sustainable performance systems that encompass economic, social, and ecological dimensions [7,66]. Building upon this approach and incorporating China's experiences [8], this study constructs a comprehensive assessment system for the high-quality development of farmers' cooperatives. The aim is to comprehensively evaluate the development situation of cooperatives, considering economic, social, and ecological factors.

Due to variations in evaluation systems, there are differing conclusions regarding the impact of arable land on the development of farmers' cooperatives. Some studies, particularly those emphasizing the economic benefits of cooperatives, often assert that arable land has a positive influence on the economic growth of cooperatives [67,68]. However, as assessment systems become more comprehensive in evaluating cooperatives, many studies suggest that the impact of arable land on the overall development of cooperatives gradually diminishes [69]. This aligns with the findings of our research. Furthermore, for cooperatives engaged in non-grain production, the role of arable land in their development also tends to weaken over time [70].

It is well-established that arable land has a positive impact on the quality development of cooperatives, meaning that as arable land scale expands, farmers' cooperatives will possess a richer resource endowment, thereby enhancing the development quality of the cooperative [42]. However, as the role of arable land continues to weaken, it is more important to explore the factors that influence the role of arable land [71,72]. As cooperatives enter a new stage of high-quality development, industrial development is considered an effective means to improve production efficiency, reduce labor costs, reduce agricultural production risks, and increase agricultural added value [73]. Xu and Guo (2022) provide a comprehensive analysis of cooperative development, emphasizing the interaction and underlying mechanisms between industrialization and cooperative performance and revealing the multifaceted dynamics provided by industrialization for cooperative development [74]. In addition, existing studies suggest that industrial development serves as a substitute for arable land, allowing cooperatives to reduce agricultural production and even transform into agricultural companies after undergoing industrial transformation and upgrading [75].

However, field research reveals that this theory does not align with the actual situation. The "inverted U-shaped" association between arable land and the high-quality development of cooperatives indicates that the cooperative's arable land scale and industrial development are complementary rather than substitutive. This is because cooperatives are fundamentally agricultural organizations deeply rooted in rural communities and among farmer populations, making it challenging to achieve fully enterprise-oriented development [76]. Therefore, in the early stages of cooperative development, expanding arable land scale can fully leverage economies of scale. More importantly, as cooperatives increase investment in industrial development, expanding into processing, sales, and other aspects, the key to development lies in balancing the cooperative's arable land output and industrial development capabilities. This ensures that processing and sales capabilities match production capabilities, avoiding resource wastage.

Therefore, in the context of high-quality development, cooperatives should not blindly expand their production and operation scale. It is essential to ensure that industrialization investment maximally leverages the advantages of arable land scale, preventing the suppression of high-quality development due to scale expansion.

6. Conclusions and Implications

6.1. Conclusions

In the dual context of increasingly scarce arable land resources and the high-quality development of agriculture, exploring the mechanism of the impact of arable land on the high-quality development of farmers' cooperatives is important for promoting the quality of farmers' cooperatives and sustainable agricultural development. This paper conducts on-site investigations on 448 farmers' cooperatives. Through theoretical analysis and statistical analysis of sample data, it is found that both excessively large and excessively small arable land scale will lead to a decline in the development quality of farmers' cooperatives. Even among cooperatives with similar arable land scale, there is considerable variability in development quality. To further explore the complex relationship between them, this paper utilizes survey data for empirical analysis and draws the following conclusions:

(1) There is a significant positive relationship between arable land scale and the development quality of cooperatives, as the larger the arable land scale, the higher the development quality of cooperatives.

(2) After adding the squared term, there is an "inverted U-shaped" association between arable land scale and the development quality of cooperatives. As arable land scale continuously expands, the development quality of cooperatives first increases and then decreases.

(3) Upon classifying cooperative development quality into five categories (economic foundation, innovation capability, green development, standardization, and social value), regression results for each category still show a significant "inverted U-shaped" association. However, there is strong variability in the impact on development quality in different categories.

(4) Analyzing the phased characteristics of the "inverted U-shaped" association between arable land scale and high-quality development of cooperatives reveals four stages, "weak impact—rapid improvement—diminishing growth effect—decline in development quality", as cooperatives' arable land scale increases.

(5) Industrial development is a conditional factor affecting the establishment of the "inverted U-shaped" association between arable land scale and high-quality development in cooperatives. The intrinsic mechanism is that industrial development and arable land scale in cooperatives exhibit a strong complementary relationship rather than a substitution relationship.

6.2. Policy Implications

Arable land is an indispensable basic resource for the high-quality development of farmers' cooperatives. However, considering the heterogeneity among different cooperatives, it is crucial to pay attention to the moderate expansion of arable land scale. The research findings of this paper have enlightening implications for the government to guide the allocation of arable land in cooperatives and thereby promote the high-quality development of farmers' cooperatives. Firstly, the government should guide cooperatives to consider their own situations. For cooperatives with smaller arable land scale, utilizing land transfer to achieve economies of scale can rapidly improve development quality. Secondly, for cooperatives with larger arable land scale engaged in industrial development, the government should guide these cooperatives to align their industrial development capabilities with arable land production capacity. Additionally, reinforcing standardized and refined management can leverage the complementary effects of resources. Finally, for cooperatives with relatively abundant arable land resources, especially during stages where saturation in industrial development may occur in the short term, it is essential to fully leverage human resources and other innovative inputs. This will better promote the high-quality development of farmers' cooperatives, ensuring their competitiveness in the ever-changing market environment.

6.3. Research Limitations and Prospects

This study has certain limitations, which can be further expanded upon in future research. While the paper extensively analyzes the impact of arable land scale on the high-quality development of farmers' cooperatives and identifies industrial development as a key factor influencing the inverted U-shaped relationship, future research could explore the significant role of certain factors, such as human capital and social capital, in the high-quality development of farmers' cooperatives. To better understand the role of arable land scale, the paper only utilizes data from grain-production-type cooperatives in three major grain-producing regions in China. Future researchers may consider larger sample sizes and conduct comparative analyses using data from various types of cooperatives.

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Abbreviations

Acronyms and Symbols	Description
EB	Economic Basis
IC	Innovation Capability
GD	Green Development
SL	Standardization Level
SV	Social Value
CDQ	Cooperative Development Quality
CCC	Characteristics of Cooperative Chairman
BCC	Basic Characteristics of Cooperative
OMCC	Operational and Management Characteristics of Cooperative
ALS	Arable Land Scale
ALS^2	Square of Arable Land Scale
IV1	Average Household Arable Land
IV2	Square of Average Household Arable Land
ALD	Arable Land Distribution
IDI	Industrial Development Investment

Appendix A. Survey Questionnaire on Farmers' Cooperative Development

We are the Agricultural Economics Research Team from Northeastern Agricultural University. We sincerely invite you to participate in this research. The name of the research project is the relationship between land endowment and the high-quality development of farmers' cooperatives. Before you decide whether to do the questionnaire or not, please read the following carefully.

Research Purpose:

The objective of this study is to delve into the relationship between land endowment and the high-quality development of farmers' cooperatives. We will investigate the basic characteristics of the chairperson of farmers' cooperative, the scale of arable land, and the overall development of farmers' cooperative. The aim is to gain crucial insights into the nexus between land endowment and the development of farmers' cooperatives.

Privacy and Confidentiality:

Your personal information will be strictly confidential, unless otherwise required by applicable laws and regulations. The research findings will solely be utilized for academic research purposes and will not be employed for any other purposes.

Rights and Voluntary Participation:

You have the right to refuse participation or withdraw from the study at any point without facing any adverse consequences. You may raise concerns or questions at any time, and we will provide satisfactory explanations.

Consent to Participate:

I have read and understood the information provided above. I voluntarily agree to participate in this study and acknowledge my right to withdraw at any time.

Researcher's Contact Information:

Name:
E-mail:
Survey Code: Survey Location: Survey Date: Surveyor:
Respondent's Name: Phone Number: E-mail:

1. Basic Information of the Farmers' Cooperative

(1) Cooperative Name: [Fill in the blank]
(2) Location of the Cooperative: [Fill in the blank]
(3) Registration Date of the Cooperative: [Fill in the blank]
(4) Number of Cooperative Members (people): [Fill in the blank]
(5) Total Assets of the Cooperative (thousands of RMB): [Fill in the blank]
(6) Number of Large Agricultural Machinery Owned by the Cooperative, where large agricultural machinery refers to those with a power of 50 horsepower or above (units): [Fill in the blank]
(7) Main Agricultural Products Operated by the Cooperative: [Multiple-choice]
1) Rice 2) Wheat 3) Corn 4) Other
(8) Demonstration Level of the Cooperative: [Single-choice]
1) Non-demonstration cooperative 2) County-level 3) City-level 4) Provincial-level 5) National-level
(9) Does the Cooperative Have a One-Person-One-Vote System for Major Decision-Making? [Single-choice]
1) Yes 2) No
(10) Does the Cooperative Have a Rebate System? [Single-choice]
1) Yes 2) No
(11) Distance from the Cooperative to the Nearest County Town (km): [Fill in the blank]
(12) Distance from the Cooperative to the Nearest Financial Institution (km): [Fill in the blank]
(13) Average Attendance Rate of Members in the Cooperative's 2022 Annual Meeting (%): [Fill in the blank]
(14) Average Participation Rate of Members in the Cooperative's 2022 Member Skills Training Activities (%): [Fill in the blank]

2. Basic Information of the Chairperson of the Cooperative

(1) Gender of the Chairperson of the Cooperative: [Single-choice]

1) Male 2) Female

(2) Age of the Chairperson of the Cooperative: [Fill in the blank]

(3) Educational Level of the Chairperson of the Cooperative: [Single-choice]

1) Elementary school and below 2) Junior high school 3) High school/Technical secondary school 4) College 5) Bachelor's degree and above

(4) Is the Chairperson of the Cooperative a Village Official? [Single-choice]

1) Yes 2) No

3. Relevant Information on the High-Quality Development of the Cooperative

(1) Cooperative's Operating Income in 2022 (CNY 10,000): [Fill in the blank]

(2) Cooperative's Operating Profit in 2022 (CNY 10,000): [Fill in the blank]

(3) Cropland Area Sown by the Cooperative in 2022 (hectares): [Fill in the blank]

(4) Total Agricultural Production of the Cooperative in 2022 (tons): [Fill in the blank]

(5) Quantity of Processed Agricultural Products by the Cooperative in 2022 (tons): [Fill in the blank]

(6) Quantity of Agricultural Products Sold through Grain Merchants by the Cooperative in 2022 (tons): [Fill in the blank]

(7) Quantity of Agricultural Products Sold by the Cooperative through Enterprise Specialty Stores, Online Sales, Order Production, Supermarket Connections, and Rural Tourism in 2022 (tons): [Fill in the blank]

(8) Number of Agricultural Production Standards Formulated and Adopted by the Cooperative in 2022 (units): [Fill in the blank]

(9) Number of Patents Applied for by the Cooperative in 2022 (units): [Fill in the blank]

(10) Cropland Area Sown with Superior Crop Varieties Adopted by the Cooperative in 2022 (hectares): [Fill in the blank]

(11) Number of Registered Trademarks Owned by the Cooperative as of 2022 (units): [Fill in the blank]

(12) Brand Influence Range of the Cooperative: [Single-choice]

1) No independent brand 2) County-level 3) City-level 4) Provincial-level 5) National-level 6) Export sales

(13) Production Area in 2022 with Reduced Chemical Fertilizers and Pesticides by the Cooperative (hectares): [Fill in the blank]

(14) Percentage of Comprehensive Treatment and Utilization of Crop Straw, Agricultural Plastic Film, Packaging Bags for Fertilizers and Pesticides, and Related Waste by the Cooperative in 2022 (%): [Fill in the blank]

(15) Number of Agricultural Product Certifications (including "Pollution-Free Agricultural Products," "Green Agricultural Products," "Organic Agricultural Products," and "Geographical Indication Agricultural Products"): [Single-choice]

1) No certification 2) One certification 3) Two certifications 4) Three certifications 5) Four certifications

(16) Quantity of Agricultural Products Clearly Displayed on Cooperative's Product Packaging or Labels in Terms of Production, Processing, or Sales Processes (tons): [Fill in the blank]

(17) Number of Times the Cooperative's General Meeting for Members was Held in 2022 (times/year): [Fill in the blank]

(18) Number of Times the Cooperative's Board of Directors was Convened in 2022 (times/year): [Fill in the blank]

(19) Proportion of Provident Fund Withdrawal by Cooperative Members in 2022 (%): [Fill in the blank]

(20) Distributable Surplus Amount in 2022 by the Cooperative (CNY 10,000): [Fill in the blank]

(21) Amount of Surplus Refunded by the Cooperative in 2022 (CNY 10,000): [Fill in the blank]

(22) Number of Times in 2022 the Cooperative Publicly Disseminated Financial Information through Postings, Mass Distribution, etc., for All Members to Understand Financial Information (times/year): [Fill in the blank]

(23) Number of Times in 2022 the Cooperative Consolidated Income and Expenditure Accounts by Accounting (e.g., monthly frequency is 12, quarterly frequency is 4) (times/year): [Fill in the blank]

(24) Total Amount of Direct Economic Support Provided by the Cooperative for Village Construction and Development, such as Cooperative Contributions to Village Road Repair, etc. (CNY 10,000): [Fill in the blank]

(25) Number of Cooperative Partnerships with Other Cooperatives and Enterprises, with Cooperation Duration Generally Exceeding 1 Year (units): [Fill in the blank]

(26) Number of Participants in Training Opportunities Provided by the Cooperative for Members and Other Villagers in 2022 (people): [Fill in the blank]

(27) Number of Long-Term Employed Workers by the Cooperative, Considering the Seasonal Nature of Agriculture (defined as workers employed for more than 4 months in the entire year) (people): [Fill in the blank]

4. Current Situation of Cooperative Resource Input

(1) Cooperative's Arable Land Scale (hectares): [Fill in the blank]

Total Scale: Scale Contributed by Members: Leased Land Scale:

(2) Number of Villages Where the Cooperative Operates Arable Land: [Fill in the blank]

(3) Does the Cooperative Engage in Industrial Development? [Single-choice]

1) Yes 2) No

(4) If yes, what is the investment in industrial development (CNY 10,000)? [Fill in the blank]

(5) Number of Full-time Staff in the Cooperative: [Fill in the blank]

(6) Does the Cooperative Hire Professional Managers? [Single-choice]

1) Yes 2) No

(7) Does the Cooperative Have Agricultural Technology Introduction? [Single-choice]

1) Yes 2) No

(8) If yes, how many types of agricultural technology have been introduced (types)? [Fill in the blank]

(9) Does the Cooperative Have Unified Purchase of Agricultural Insurance? [Single-choice]

1) Yes 2) No

(10) Amount Spent by the Cooperative on Hospitality Expenses (CNY 10,000): [Fill in the blank]

(11) Percentage of Cooperative Members' Sales through the Cooperative (%): [Fill in the blank].

Appendix B. Interview Outline for Cooperative Chairperson

1. Background and Introduction

(1) Please introduce your cooperative, including the establishment time, main business, and development history.

(2) How do you define the development quality of the cooperative? Which factors do you consider most important for development quality?

(3) How competitive do you think the current agricultural product market is?

(4) How do you perceive the demand for the agricultural products you operate in the current market among relevant consumers?

(5) Have there been significant changes in the development plan of the cooperative in recent years? If so, what are the reasons?

2. Cooperative Resource Input Situation

(1) How is the demand for arable land scale in your cooperative? Does the cooperative have a significant demand for arable land? How much land does the cooperative need to obtain through leasing? Will expanding the arable land face obstacles?

(2) Does your cooperative process agricultural products? Does the cooperative have its own sales channels?

(3) Will the arable land scale of your cooperative consider the level of industrialization investment?

(4) Does your cooperative lack professional management, accounting, technical, and sales personnel? What channels are typically used when hiring professional staff?

(5) How intense is the focus of your cooperative on technology introduction? Has the technology introduced by your cooperative been fully utilized? What impact does technology introduction have on the cooperative's development?

(6) Does your cooperative pay attention to maintaining social relationships? How is the expenditure on social relationships? How do these relationships contribute to the development of your cooperative?

(7) How do you assess the value and contribution of the above resources to the cooperative? Considering the development history of your cooperative, do you find the demand for resources to be the same at different stages? In which stages do the mentioned resources play a crucial role?

(8) How do you determine the proportion of investment in various resources for the cooperative? Does these proportions vary based on different business and market demands?

(9) How do you coordinate and balance different types of resources to meet the overall needs of the cooperative?

(10) How do you assess the success of the cooperative's resource allocation strategy? What are your plans and expectations for future resource allocation?

3. Development Challenges

(1) How do you assess the economic benefits of the cooperative? Which indicators best reflect the financial condition and profitability of the cooperative?

(2) How do you assess the cooperative's contribution to society? What impact do you think the cooperative has on the community and local residents?

(3) How do you assess the ecological environmental impact of the cooperative? Has your cooperative taken measures to protect the environment?

(4) Do the products produced by your cooperative meet market demands? How do you assess and improve product quality?

4. Challenges and Opportunities

(1) What do you consider the biggest challenge currently facing your cooperative? How do you plan to address it?

(2) What do you see as the biggest opportunities for the development of the cooperative in the coming years? How do you plan to leverage these opportunities?

(3) How do you view the government's support for farmer cooperatives and the policy environment? Do you believe that the policy environment has a significant impact on the development of cooperatives?

(4) Are you familiar with the digital economy? What impact do you think the digital economy has on the development of cooperatives?

(5) In the context of high-quality development, what aspects do you think the cooperative will pay more attention to in the future?

Appendix C. The Descriptive Statistical Analysis of Indicators for the High-Quality Development of Cooperatives

Due to space constraints and the specific focus of our research, some details have not been fully elaborated upon in the main text of the manuscript. To ensure comprehensive

coverage and clarity, these details have been included in the appendix. Specifically, Table A1 comprises a descriptive statistical analysis of indicators pertaining to the high-quality development of cooperatives. This supplemental information offers additional data and insights to complement the findings discussed in the paper.

Table A1. The descriptive statistical analysis of indicators for the high-quality development of cooperatives.

Primary Indicator	Secondary Indicator	Tertiary Indicator	Mean	SD	Min	Max
Economic Basis (EB)	Profitability	Average Income per Member (CNY 10,000)	1047.370	2039.968	30	15,000
		Operating Profit (CNY 10,000)	138.487	419.284	3.2	4000
	Industry Integration	Processing Proportion (%)	41.529	26.605	0	100
		New Sales Methods (%)	41.632	26.536	0	100
Innovation Capability (IC)	Technological Innovation	Standards/Patents (pcs)	1.908	1.906	0	10
		Application of Fine Seeds (%)	81.384	15.065	50	100
	Cooperative Branding	Registered Trademarks (pcs)	0.725	1.681	0	12
		Brand Coverage (1~6)	1.717	1.417	1	6
Green Development (GD)	Ecological Protection	Proportion of Reduced Chemical Area (%)	6.549	11.647	0	50
		Recycling Rate of Agricultural Waste (%)	74.580	16.843	10	100
	Product Safety	Quality Certification Standards (1~5)	1.460	1.053	1	5
		Traceability Proportion (%)	5.795	13.436	0	80
Standardization Level (SL)	Operational Standards	Frequency of Member Meetings/Director Meetings (times/year)	2.288	1.863	1	12
		Proportion of Distributable Surplus Returned (%)	18.150	24.890	0	101
	Financial Standards	Frequency of Financial Report Disclosure (times/year)	2.844	3.292	0	12
		Frequency of Accounting (times/year)	4.007	3.509	1	24
Social Value (SV)	Social Participation	Investment in Village Collective Construction (CNY 10,000)	22.165	120.646	0	2000
		Number of Cooperative Enterprises/Other Cooperatives (pcs)	2.156	3.457	0	18
	Training and Employment	Number of People Trained in Farmer Training Projects (ppl)	55.647	111.930	0	583
		Number of Jobs Created by the Cooperative (pcs)	6.924	13.795	0	70

Appendix D. Specific Explanation of Tertiary Indicators for the High-Quality Development of Cooperatives

In Table A2, we provide detailed explanations of the tertiary indicators for the high-quality development of cooperatives. While these explanations were not extensively discussed in the main body of the manuscript due to space constraints, we have included them here for clarity and completeness.

Table A2. Specific explanation of tertiary indicators for the high-quality development of cooperatives.

Tertiary Indicator	Meaning
Average Income per Member (CNY 10,000)	Operating Income per Member Household
Operating Profit (CNY 10,000)	Cooperative's Operating Profit
Processing Proportion (%)	Quantity of Processed Agricultural Products to Total Agricultural Products Production

Table A2. *Cont.*

Tertiary Indicator	Meaning
New Sales Methods (%)	Quantity of Agricultural Products Sold through Specialty Stores, Online Sales, Order Production, Supermarket Connections, and Rural Tourism by the Cooperative to Total Agricultural Products Production
Standards/Patents (pcs)	Sum of the Number of Standards Formulated by the Cooperative and the Number of Patents Applied
Application of Fine Seeds (%)	Proportion of Cultivated Area for Superior Crop Varieties to Total Crop Sowing Area
Registered Trademarks (pcs)	Number of Registered Trademarks Owned by the Cooperative
Brand Coverage (1~6)	1 = No independent brand; 2 = County-level; 3 = City-level; 4 = Provincial-level; 5 = National-level; 6 = Export sales
Proportion of Reduced Chemical Area (%)	Production Area with Reduced Use of Fertilizers and Pesticides to Total Crop Sowing Area
Recycling Rate of Agricultural Waste (%)	Percentage of Comprehensive Treatment and Utilization of Crop Straw, Agricultural Plastic Film, Packaging Bags for Fertilizers and Pesticides, Agricultural Machinery, and Related Waste to Total Waste
Quality Certification Standards (1~5)	Number of Chinese Government-Certified Pollution-Free Agricultural Products, Green Agricultural Products, Organic Agricultural Products, and Geographical Indication Agricultural Products
Traceability Proportion (%)	Proportion of Agricultural Products Displaying the Cooperative's Name Clearly on Packaging or Labels to the Total Agricultural Product Quantity
Frequency of Member Meetings/Director Meetings (times/year)	Sum of the Number of General Meetings for Members and the Number of Board of Directors Meetings in the Cooperative
Proportion of Distributable Surplus Returned (%)	Amount of Surplus Refunded to Distributable Surplus Amount
Frequency of Financial Report Disclosure (times/year)	Number of Times Financial Statements Were Publicized to All Members through Postings, Mass Distribution, etc.
Frequency of Accounting (times/year)	Number of Times the Unified Summary of Income and Expenditure Accounts by the Accountant
Investment in Village Collective Construction (CNY 10,000)	Total Direct Economic Support Provided by the Cooperative for Village Construction and Development
Number of Cooperative Enterprises/Other Cooperatives (pcs)	Number of Partnerships
Number of People Trained in Farmer Training Projects (ppl)	Number of Participants in Training Opportunities Provided for Members and Other Villagers
Number of Jobs Created by the Cooperative (pcs)	Number of Job Positions Offering Employment for More Than 4 Months

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