



Research on the Way of Benefit Sharing in Agricultural Supply Chain Under Blockchain and the Coordinated Promotion of the Channel to Russia

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Abstract. The application of blockchain quality traceability technology in the supply chain sector is a hot topic. There is an urgent need to develop a shared benefit model for agricultural product supply chains that can be effectively promoted to farmers, addressing the issue of unreasonable profit distribution in these chains. This study focuses on the agricultural product supply chain centered around the purchasing entity, conducting a questionnaire survey of relevant personnel to analyze the shared benefit model and influencing factors of agricultural products. The findings indicate that, first, there are four methods of shared benefit in the agricultural product supply chain under the blockchain context; second, for the shared benefit model that farmers are most likely to accept and can implement blockchain quality traceability, multiple Logit choice models were applied to determine the selection mechanism of the shared benefit method. This primarily includes the positive and significant impact of farmers' annual income and long-term cooperation on promoting the shared benefit method of blockchain technology for quality traceability. By analyzing the characteristics of blockchain and supply chain needs, a shared benefit mechanism is constructed to promote the construction of the Russia channel. The aim is to enhance supply chain efficiency and transparency, optimize logistics, reduce costs, and promote the export of agricultural products and Sino-Russian trade.

Keywords: agricultural supply chain, blockchain, construction of channel to Russia

1 Introduction

The Ministry of Commerce and seven other departments have issued the 'Special Action Plan for Accelerating the Development of Digital and Intelligent Supply Chain' (Shang Chuang Gong Han [2025] No.56). The plan proposes to use new technologies such as artificial intelligence, the Internet of Things, and blockchain to implement a tailored strategy for each supply chain, promoting the digitalization, intelligence, and visualization of the supply chain, thereby enhancing its operational efficiency and resilience. It emphasizes improving the organizational level of agricultural

supply chains, developing smart agriculture, and deeply implementing the 'Internet +' project to facilitate the flow of agricultural products from rural areas to cities. This initiative aims to promote the digital transformation of all agricultural sectors and links, drive the high-quality development of rural e-commerce, and ensure the smooth flow of agricultural products from the 'first mile' of the supply chain. The '14th Five-Year Plan for Agricultural and Rural Modernization' proposes to strengthen the backbone network for agricultural product circulation, optimize the layout of cold chain logistics for agricultural products, advance the construction of storage, preservation, and cold chain logistics facilities for agricultural products, and improve the regulatory system for cold chain transportation of agricultural products. These measures provide a foundation for optimizing the agricultural product supply chain and support agricultural companies in conducting circulation business with Russia, actively boosting farmers' income and enhancing the economic and social benefits of agricultural enterprises.

In agricultural supply chains, the use of blockchain technology for quality traceability is a quality-management system that collects, encrypts and shares critical quality information about produce in real time throughout its entire life cycle. By accurately tracking product history, usage and location, the system ensures that quality data are authentic, complete and transparent, enabling rapid identification and effective resolution of quality issues while boosting consumer trust and corporate reputation. Farmers can experience the benefits blockchain brings them, or, having gained a basic understanding of the technology, may wish to join blockchain-based collaborations. Under such a traceability framework, an equitable benefit-sharing mechanism is urgently needed. Through investigation and analysis of benefit-sharing models and their influencing factors, and by aligning blockchain's characteristics with the practical needs of agricultural supply chains, an effective benefit-sharing mechanism can be designed. This mechanism will promote the construction and development of Russia-bound trade corridors, enhance overall supply-chain efficiency and transparency, optimize logistics and distribution, cut costs, and in turn strengthen agricultural export trade—injecting fresh momentum into China–Russia trade cooperation and elevating it to a new level.

2 Literature Review

2.1 The Problem of Profit Distribution in Agricultural Supply Chain

The agricultural product supply chain is a complex network involving farmers, brokers, wholesalers, logistics providers, retailers, and consumers[1]. The core issue in this supply chain is the distribution of benefits. [2] In the agricultural product supply chain, there are issues of unfair benefit distribution, which can directly lead to problems such as the breakdown of supply chain relationships, low integration of information and resources, insufficient collaboration among supply chain members, and unstable channel relationships[3]. Clearly, the cooperative relationships formed by economic entities in the supply chain, aimed at maximizing their own interests, re-

quire fair benefit distribution among supply chain members to foster long-term stable cooperation.

2.2 Research Methods on the Mechanism of Choosing the Way of Benefit Sharing in Agricultural Product Supply Chain

There are two ways to choose the mechanism of profit sharing in agricultural product supply chain: one is to study its mechanism by constructing a supply chain management optimization model [4]; the other is to study the mechanism of selection mode according to the utility maximization theory. The latter is more suitable for this study and is suitable for multiple Logit selection models [5].

Basic research on the determinants of benefit-sharing model selection remains scarce. A revenue-sharing model is a business or cooperative framework in which two or more participants-such as platforms and users, firms and partners, or investors and entrepreneurs-collaboratively create value and then distribute the resulting economic gains (profits, revenues, commissions, etc.) according to pre-agreed rules and proportions. In general, the factors influencing the choice of a benefit-sharing model can be grouped into three categories: macro-level factors, supply-chain participant factors, and supply-chain intrinsic factors.

3 Construction of the Model for selecting the way of Benefit Sharing in Agricultural Supply Chain Under the Background of Blockchain

3.1 Selection of Profit Sharing Methods for Agricultural Products Supply Chain Acquisition

Since only four households chose other methods of benefit sharing, the data volume is relatively small and has been excluded from the dependent variable Y_i . The method of benefit sharing between farmers and agricultural product buyers is represented as a dependent variable $=n$ ($n=1,2,3,4$; $i=1,2,\dots,n$). Specifically, $n=1,2,3,4$ indicates that when the transaction volume reaches a certain level, rebates are provided; when the transaction volume reaches a certain level, the purchasing entity offers discounts on agricultural inputs to farmers; under long-term cooperation, the purchasing entity and farmers share information about sales channels; if the purchasing entity has a good reputation, it can rely on trust relationships for credit-based cooperation in Table 1.

Table 1. The meaning of variables of profit sharing in agricultural supply chain acquisition

explained variable	Variable meaning
Shared benefits approach (Y)	The rebate is 1 when the transaction volume reaches a certain amount When the transaction volume reaches a certain amount, the acquisition subject gives farmers a discount on cen-

tralized purchase of agricultural materials =2,
 Under the condition of long-term cooperation, the information sharing sales channel between the acquisition subject and farmers = 3,
 The acquisition subject has a good reputation and relies on trust relationship for credit mortgage cooperation =4

3.2 Selection of Influencing Factors of Profit Sharing in Agricultural Supply Chain Acquisition

There are 11 variables affecting the way of benefit sharing between farmers and purchasers, which are taken as explanatory variables. m represents its serial number (m=1...11), which changes with the individual subject but not with the way of benefit sharing. The specific meanings of the variables are shown in Table 2.

Table 2. The meaning of the influencing factors of the acquisition benefit sharing method in the agricultural supply chain

explanatory variable	Variable meaning
sex ()X ₁	Male = 1, female =2
age ()X ₂	Under 18 years old = 1, 18-30 years old = 2, 31-40 years old = 3, 41-50 years old = 4, 51-60 years old = 5, over 60 years old =6
annual earnings X ₄ ()	i≤3=1, 3<i≤5=2, 5<i≤10=3, 10<i≤20=4, 20<i≤50=5, i>50=6
plant area ()X ₅	S≤20=1, 20<S≤50=2, 50<S≤100=3, 100<S≤500=4, 500<S≤1000=5, 1000<S≤2000=6, S>2000=7
The difference in price at which agricultural products X ₇ are sold to different buyers ()	Different = 1, not so different = 2, basically the same = 3, the same =4
A way of long-term cooperation X ₈ ()	Orders at the beginning of the year = 1, oral agreements = 2, orders over 2 years = 3, others =4
The willingness of farmers and purchasers to share benefits X ₁₀ and risks ()	Yes = 1, no =2
Evaluate the performance of oral agreements or contracts with cooperative X ₁₁ acquisition entities ()	Non-performance = 1, partial performance = 2, full performance =3
Characteristics of willingness to cooperate X ₁₂ in the application of blockchain technology ()	More than 1% = 1, more than 1.10% = 2, more than 20% = 3, more than 30% = 4, more than 40% = 5, more than 50% =6
The type of punishment that farmers can X ₁₃ accept after default ()	Payment penalty = 1, land transfer management right to the partner until the termination of cooperation = 2, others =3
The way farmers cooperate in the process of	The purchase subject provides technical

information uploading X_{14} using blockchain technology ()

personnel, and the cost is paid by the farmer himself =1; the purchase subject provides technical personnel, and the cost is paid by the cooperative where the farmer is located =2; the purchase subject provides technical training, serves itself, and can charge service fees in the process of serving others =3; other =4

The proportion of the total production cost that farmers are X_{15} willing to pay ()

1%-5%=1.5%-10%=2, 10% above =3

The extent to which farmers need blockchain X_{16} technology training ()

Once a week = 1, once a month = 2, once a quarter = 3, once every six months = 4, once a year or more =5

3.3 Construction of Multiple Logit Models for the Choice of Benefit Sharing Methods in Agricultural Supply Chain

The mechanism of choosing the benefit-sharing method in agricultural product supply chain acquisition. Using in the hypothesis of individual utility function proposed by McFadden, if farmers choose the benefit-sharing method, their utility function is:

$$U_{in} = \beta_n x_i' + \varepsilon_{in} \tag{1}$$

In the formula, x_i is the characteristic variable, which represents the influencing factors of the related purchase benefit sharing method; β_n is the coefficient vector, which indicates the mechanism of influence on the choice of agricultural farmers to acquire benefit sharing method; ε_{in} is the random error term (assuming that they are independent of each other and follow the I-type standard extreme value distribution).

Based on the maximum likelihood estimation method, the model is estimated by Stata SE 15 software. According to the frequency index of farmers' acceptance, the base item is the rebate when the transaction volume reaches a certain amount. The estimation results are shown in Table 3.

3.4 Results and Discussion

Through the establishment of a number of Logit models for the profit sharing method of agricultural products supply chain acquisition, the model shows that LR $\chi^2(48) = 172.69$, Prob > $\chi^2 = 0.0000$, Pseudo $R^2 = 0.3618$, and the fitting degree is good, and the model is significant. The estimation results are shown in Table 3.

Table 3. Results of the selection model of profit sharing methods in agricultural product supply chain acquisition

explain variable	When the transaction volume reaches a certain amount, the acquisition entity will give discounts on agricultural materials purchased by farmers in bulk / when the transaction volume reaches a certain amount, it will return rebates	Under the condition of long-term cooperation, the acquisition subject and farmers share information about sales channels and transaction volume up to a certain amount for rebate	The acquisition subject has a good reputation and relies on trust relationship for credit mortgage cooperation/trading volume up to a certain amount for rebate
	Coef	certain amount for rebate Coef	Coef
X ₁	0.16	1.22	1.22*
X ₂	0.55*	-0.04	-0.10
X ₄	0.31	0.59	2.64***
X ₅	-1.03**	-1.19	-1.84***
X ₇	0.26	-1.39*	0.47
X ₈	1.49**	1.03	-0.14
X ₁₀	0.38	0.89	1.76**
X ₁₁	0.31	2.08**	-0.04
X ₁₂	-0.41*	-0.38	-0.28
X ₁₃	-0.53*	-1.67**	-0.26
X ₁₆	0.13	-0.06	-1.01***

Note: *, ** and *** indicate significance at the level of 10%,5% and 1% respectively.

3.5 The Mechanism by Which the Acquisition Subject Chooses to Adopt the Profit-Sharing Method of Rebate Acquisition for Farmers

The mechanism for selecting the profit-sharing method in the rice procurement supply chain, when promoting blockchain technology for quality traceability, is that farmers are most receptive to a rebate when the transaction volume reaches a certain level. The selection mechanism of the profit-sharing method mainly includes the farmers' annual income and the long-term cooperation model, which positively influence the profit-sharing method for promoting blockchain technology for quality traceability. However, the penalties for farmers after a breach and the extent to which farmers need blockchain technology training negatively impact the profit-sharing mechanism for promoting blockchain technology for quality traceability.

4 Measures to Promote the Distribution of Benefits of Cooperation in Agricultural Supply Chain Under the Background of Blockchain

4.1 The Acquisition Subject Emphasizes the Rebate Incentive Clause in the Order

To ensure the continuous and stable distribution of the maximum cooperative benefits in the agricultural product supply chain, the purchasing entity can emphasize rebate

incentives when signing orders with farmers. According to the results from the mechanism of choosing the benefit-sharing method for the acquisition of agricultural products under the blockchain context, the rebate incentive has a positive and significant impact on promoting the benefit-sharing method through long-term cooperation. This suggests that when using blockchain technology for quality traceability in the rebate acquisition benefit-sharing method, it is advisable to focus on the rebate incentive clauses in long-term orders with farmers. In the blockchain context, the purchasing entity and farmers can sign orders to emphasize the use of rebates to incentivize farmers, thereby reducing supply chain operating costs and ensuring the stability of the rice acquisition supply chain.

4.2 Measures Taken by the Acquisition Subject to Reduce Cooperation Risks

To ensure the continuous and stable implementation of the optimal cooperation benefit distribution plan in the agricultural product supply chain, it is crucial to reduce the cooperative risks for farmers when the purchasing entity and the farmer alliance collaborate. The results from the mechanism of choosing the profit-sharing method in the agricultural product supply chain acquisition under the blockchain context show that the willingness of farmers and the purchasing entity to share benefits and bear risks positively influences the mechanism of profit sharing through quality traceability using blockchain technology. This indicates that farmers are unwilling to share benefits and bear risks with the purchasing entity, and they do not trust such a partnership. Therefore, to promote the optimal cooperation benefit distribution plan in the agricultural product supply chain, efforts should focus on reducing the level of risk. The purchasing entity's business activities require active cooperation from farmers. Relying solely on contracts to avoid cooperation risks is insufficient; a strong trust relationship must be established between the purchasing entity and the farmers to reduce the cooperative risks.

4.3 The Acquisition Subject Shall Require the Blockchain Quality Traceability Platform Enterprise to Provide Training Times

To ensure the continuous and stable implementation of the maximum cooperative benefit distribution plan in the agricultural product supply chain, the purchasing entity can request that blockchain quality traceability platform companies increase the frequency of training sessions for farmers on blockchain technology. The results from the mechanism of profit sharing methods in the agricultural product supply chain acquisition under the blockchain context show that the level of blockchain technology training required by farmers has a negative and significant impact on the mechanism of profit sharing through blockchain quality traceability. This suggests that farmers need more frequent blockchain technology training, which can be facilitated by the purchasing entity to encourage blockchain quality traceability platform companies to provide more training sessions. By providing blockchain technology training to farmers, they can gain a better understanding of how blockchain technology affects the

distribution of benefits in the supply chain, the essence of blockchain technology for quality traceability, and its benefits.

5 Conclusion

5.1 Technical Level

In the research and development and application of blockchain technology, we should increase r&d investment in blockchain technology in agricultural product supply chain and Russia channel scenarios, improve technical performance and security, and expand application scenarios, such as intelligent packaging, integration of Internet of Things and blockchain.

In terms of information standardization, unified information standards for agricultural supply chain and logistics information for Russia are formulated to ensure the consistency of data format, coding rules and interface specifications, so as to provide basic guarantee for information coordination.

5.2 Management Level

Establish a blockchain-based agricultural supply chain collaborative management platform in the supply chain collaborative management, strengthen the communication and collaboration among the main bodies of the supply chain, realize the coordination of planning, scheduling, inventory and other management functions, and improve the response speed and flexibility of the supply chain.

In terms of channel operation optimization, the operation of the Russia channel should be optimized, the maintenance and upgrading of channel infrastructure should be strengthened, the customs clearance efficiency should be improved, the logistics cost should be reduced, and an efficient, convenient and stable agricultural products export channel should be built.

5.3 Policy Level

In terms of policy support and coordination, government departments have issued relevant policies to encourage enterprises to adopt the blockchain-based agricultural supply chain model, increase capital investment and support for the construction of channels to Russia, and strengthen policy coordination to form a policy synergy and promote coordinated development.

Strengthen the supervision of agricultural product supply chain and Russia channel in terms of regulation and guarantee to ensure product quality, food safety and trade security; establish and improve the legal system to provide legal guarantee for the application and coordinated development of blockchain technology.

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