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Research Article

Profit Coordination and Optimization of Agricultural Product Brand Promotion Lead by Farmer Cooperative Organizations

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In the e-commerce supply chain of agricultural products, there are three parties: farmer cooperative organizations, e-commerce platforms, and consumers. This study aims to investigate how to coordinate farmer cooperative organizations and e-commerce platforms to maximize the overall profits of the supply chains of agricultural products. Based on the Stackelberg game theory, this paper constructs a two-level supply chain decision-making model led by farmers' cooperatives and followed by e-commerce platforms. It discusses two supply chain decision-making models (decentralized and centralized) with decision variables (selling price and promotion effort). The results show that the overall profit of the supply chain under centralized decision making is higher than the overall profit under decentralized decision making. In order to achieve the coordination of agricultural product sales price and brand promotion efforts and achieve win-win cooperation, this paper puts forward two coordination schemes: (1) coordinating revenue sharing, cost sharing, and wholesale price discounts and (2) coordinating the wholesale price. These two contract coordination schemes are verified by example analysis. Finally, the following strategies are recommended, including strengthening the investment in brand promotion and contract management.

1. Introduction

In the past, due to the imbalance in the bargaining power of the supply and demand sides, the supply side only can sell agricultural products to buyers at low prices, which affected the circulation efficiency of agricultural products and restricted the healthy development of agricultural products in China [1]. In recent years, the rapid development of e-commerce has provided an opportunity to expand the sales channels of agricultural products in China. According to commerce big data monitoring, China's online retail sales of agricultural products reached RMB 422.1 billion in 2021 [2]. Although the online sales of agricultural products increased, farmers' incomes did not increase much. Therefore, researchers attempt to find out a way to increase farmers' incomes.

Practices in India, Myanmar, and Poland have proved that improving the bargaining power of the supply side is the way to increase farmers' income, and establishing agricultural production organizations is an effective way to improve the bargaining power of the supply side [3–5]. In China, farmer cooperative organizations help farmers improve the quality of agricultural products to meet the market [6]. For example, the number of specialized farmers' cooperatives in Chongqing has grown from 13400 to 37300, and the participation rate of farmers has reached 44% in 2021. Therefore, farmer cooperative organizations play an essential role in the e-commerce supply chain of agricultural products [7]. The e-commerce supply chain of agricultural products has three parties: farmer cooperative organizations, e-commerce platforms, and consumers. Then, the research question of the study is how to coordinate farmer cooperative

organizations and e-commerce platforms to maximize the overall profits of the supply chains of agricultural products.

Since the brand effect of an agricultural product is significant for the demand for the product, it is necessary to strengthen the brand construction of agricultural products [8]. However, the product brand could be strengthened by brand promotion; therefore, the brand promotion effort of an agricultural product could affect the online sales of the agricultural product [9, 10]. The improvement of the bargaining power of farmers' cooperatives enables farmers' cooperatives to play a leading role in the agricultural product e-commerce supply chain [11]. The brand promotion efforts of e-commerce platforms can make agricultural products stand out and significantly increase sales. Both parties can significantly improve their profits and achieve win-win results through cooperation.

In reality, due to farmers' cooperatives' weak brand promotion awareness, the brand effect is yet to be fully utilized [12]. The failure to reach a consensus on cooperation between farmers' cooperatives and e-commerce platforms resulted in farmers' participation in online platform sales. However, their income still did not increase substantially [13]. Based on this, the main research questions of this study are as follows. (1) What mechanism do the farmer cooperatives and e-commerce platforms use to achieve supply chain coordination? (2) What are the coordination channels and programs between farmers' cooperatives and e-commerce platforms?

For this reason, this study constructs a secondary agricultural product supply chain decision-making model with farmers' cooperatives as the leader and e-commerce platforms as the follower. First, it compares the profit relationship of each decision variable and decision subject under the decentralized decision and centralized decision. Then, the coordination mechanism of the supply chain is analyzed, and different contract coordination schemes are designed. It achieves the effect of centralized decision making and realizes a win-win situation for the supply chain by promoting cooperation between e-commerce platforms and farmers' cooperatives.

This study is organized as follows. In Section 2, we present the literature review. In Section 3, we make basic assumptions and notation. Section 4 and Section 5 construct the Stackelberg game model and analyze the coordination mechanism and programs. Section 6 presents the numerical examples. We conclude this study in Section 7.

2. Literature Review

2.1. Agricultural Product Supply Chains. Previous studies on agricultural product supply chains mainly focused on the supply chain coordination [14–18], risk management [19, 20], product brand [21–23], bargaining power [3, 21, 24], etc. Some researchers also consider the impact of government subsidies on the supply chain of agricultural products [10, 25]. In the research of agricultural product supply chain coordination, researchers have studied the impact on agricultural product supply chain coordination from consumer preference [15, 16, 26] and logistics [16, 18, 27, 28]. Among all studies, most researchers believed that the brand of agricultural products is vital to the sales of agricultural products online [8]. On the other hand, most researchers believed that farmer cooperative organizations can improve the bargaining power of agricultural products and increase farmers' income [22]. But no studies have linked agricultural product brand promotion for online sales and contract coordination with farmer cooperative organizations.

2.2. E-Commerce Supply Chain for Agricultural Products. The research on agricultural e-commerce mainly focuses on the operation and financing of agricultural e-commerce, the application of blockchain technology, and supply chain coordination. Scholars generally believe that the operation of agricultural e-commerce is influenced by blockchain technology, logistics service levels, and agricultural preservation technology [29]. The application of technologies such as blockchain [30] and the Internet of Things [31] has affected the level of information technology [32, 33], quality traceability [34, 35], and electronic marketing [36, 37] of agricultural products, thereby improving the circulation efficiency of agricultural products and reducing their costs. Logistics services [18, 38], especially cold chain logistics [27, 39], and the greenness and freshness of agricultural products [40–42] have a significant impact on the online sales evaluation of agricultural products [43]. The coordination of the agricultural product e-commerce supply chain mainly focuses on logistics services [27, 38], preservation levels [18, 44], and online and offline coordination [45].

2.3. Contract Coordination Mechanism. In terms of the contract coordination mechanism of the agricultural product supply chain, researchers have established Stackelberg game models [14–16, 18, 27, 28, 46, 47] and Nash equilibrium [48] to coordinate supply chain interests. For example, Cao et al. [15] developed a game model based on cost allocation and repurchase contracts, considering sales prices and greenness. Qiu et al. [16], Zhang et al. [27], and Yu and Xiao [28] considered the impact of logistics services on the agricultural product supply chain to establish a Stackelberg game model dominated by logistics service providers. Song and He [18] and Zhong et al. [49] established a logistics service supply chain coordination model based on freshkeeping cost-sharing and revenue-sharing contracts. Yan et al. [46] studied the traditional agricultural product supply chain and established a contract coordination model based on improved revenue sharing. Niu et al. [22] put forward the coordination strategy of the wholesale price and cost sharing with the participation of farmers' cooperative organizations.

Some studies on the e-commerce supply chain and its coordination of agricultural products are shown in Table 1.

From Table 1, it can be seen that scholars' research on the coordination of agricultural e-commerce supply chain mainly focuses on logistics and distribution, with less research on the role of farmers' cooperatives in the supply chain. Game models primarily focus on e-commerce platforms or logistics service providers for research, and few

Table 1: List of key related literature.

Author(s) and ref. no	Journal title and year	Supply chain partners	Coordination strategy	Supply chain leadership	Supply chain model	Demand
Zhong et al. [10]	Agriculture-Basel, 2021	Farmers' cooperatives, e-commerce platforms, and governments	—	E-commerce platforms	Stackelberg game	Freshness, sales efforts
Qiu et al. [16]	International Journal of Environmental Research and Public Health, 2020	Third-party logistics service providers and retailers	Sharing revenues and service costs	TPLSP	Two-stage pricing, coordination, and volume loss reduction of the supply chain	Service level, freshness
Song and He [18]	Industrial Management & Data Systems, 2019	E-commerce enterprise, third-party logistics service provider (TPLSP), and a community convenience store	Cost sharing and revenue sharing	E-commerce enterprise	Stackelberg game	Freshness
Zhang et al. [27]	Neural Computing & Applications, 2020	Third-party cold chain logistic enterprise, fresh e-commerce company, and consumer	Cooperative game and non-cooperative game	Third-party cold chain logistic enterprise	Stackelberg game and benefit equilibrium analysis	Service level, freshness
Yu and Xiao [28]	Computers & Industrial Engineering, 2017	One supplier, one retailer, and one third-party logistics provider	—	The logistics provider-first scenario and the supplier-first scenario	Two Stackelberg games	Service level
Gao et al. [40]	Mathematics, 2023	Supplier, retailer, and consumers	Cost sharing, revenue sharing, and revenue and cost sharing	Supplier	Stackelberg game	Freshness-keeping effort
Li et al. [44]	Sustainability, 2022	A FAP supplier, a logistics service provider, and a large e-commerce platform	Profit-sharing and cost-sharing contract	—	Loss rate of FAP and the potential compensation costs to suppliers	Freshness, the efforts of reducing product costs
Yang et al. [45]	Sustainability, 2022	Suppliers and retailers	Contract coordination	Suppliers	Stackelberg game	Freshness
Yang et al. [47]	Industrial Management & Data Systems, 2017	Manufacturer, distributor, and retailer	Revenue-sharing contract	Retailer	Stackelberg game	Freshness
Zhong et al. [49]	Complexity, 2020	E-commerce mall, express company, and terminal distribution service provider	Revenue sharing, cost sharing, unit delivery price	E-commerce mall	Stackelberg game	Effort level of logistics service
This study		Farmers' cooperatives and e-commerce platforms	Revenue sharing + cost sharing + wholesale price discount, wholesale price coordination of agricultural products	Farmers' cooperatives	Stackelberg game	Brand promotion effort

researchers considered the impact of brand promotion on e-commerce sales of agricultural products [50]. Supply chain coordination mainly focuses on revenue sharing and cost sharing, with less consideration for contract coordination. The contribution of this study lies in the following: (1) constructing an agricultural product e-commerce supply chain led by farmers' cooperatives; (2) introducing agricultural product brand promotion and studying the impact of brand promotion on agricultural product e-commerce supply chain decision making; and (3) proposing coordination mechanism including both "revenue sharing + cost sharing + wholesale price discounts" and the coordination of wholesale prices for agricultural products.

With the vigorous promotion of "one village, one product, one town, one industry" in rural areas, the positioning of agricultural product brands has been dramatically improved. However, the responsibility and effort of product brand promotion are still on the e-commerce platforms. Therefore, it is generally believed that e-commerce platforms dominate the contract coordination mechanism. However, different contract coordination mechanisms should be examined to improve farmer cooperative organizations' bargaining power.

3. Model Description and Assumptions

3.1. Model Description. This study compared two decision-making models consisting of a farmer cooperative organization and an e-commerce platform. Suppose that (1) a farmer cooperative organization only sells one kind of agricultural product; (2) the e-commerce platform acts as a middleman, after buying that kind of agricultural product from the farmer cooperative organization, and then sells the products to consumers; and (3) the market demand for that agricultural product depends on the selling price of the agricultural product and the brand promotion effect paid by the e-commerce platform. The first decision-making model is a decentralized decision, for which, the farmer cooperative organization plays a leading role in the supply chain. The second decision-making model is a centralized decision, for which, the farmer cooperative organization and the e-commerce platform form a consortium to lead the supply chain.

3.2. Model Symbol Description. The descriptions of symbols involved in the model of this research are shown in Table 2.

3.3. Research Assumptions. The establishment of the model in this study is based on the following assumptions:

(1) All members in the agriculture supply chain system are risk-neutral.

(2) All the members are rational and make their own decisions to maximize their own profit.

(3) Using the function form used by Ghosh and Shah [51] and Zhao and Wei [52], the cost function of the e-commerce platform brand promotion is $g(e) = 1/2ke^2$ $(k > 0)$. It indicates the cost paid by the e-commerce platform to increase sales by promoting the agricultural product brand, improving popularity and reputation, while k indicates the sensitivity coefficient of the e-commerce platform to the level of brand promotion efforts.

This study includes a farmer cooperative organization f and an e-commerce platform l. Based on Liu et al. [53] and Ghosh and Shah's linear demand functions [51], the market demand D is affected by the price p and the brand promotion effort e, which decreases with the price increases and increases with the brand promotion effort. Suppose the relationship among the three (D, p, and e) is $D = D_0 - ap + be$, and $D_0 > 0$, $a > 0$, $b > 0$.

The e-commerce platform determines the selling price (sales price) of the agricultural product p and the brand promotion effort e. The farmer cooperative organization determines the wholesale price W of the agricultural product, and its unit operating cost is C. According to the market demand, the e-commerce platform decides the order quantity assuming that there is no shortage, that is, $q = D$. In order to ensure that the decision variables p, W, and e are positive, the relationship between the parameters should be satisfied that $2ak - b^2 > 0$ and $D_0 - aC > 0$. It is assumed that the operation cost of the e-commerce platform is not considered.

The profit of the e-commerce platform, the profit of the farmer cooperative organization, and the total profit of the supply chain are expressed as follows.

The market demand of the product is

$$\begin{aligned} q &= D \\ &= D_0 - \mathrm{ap} + \mathrm{be}. \end{aligned} \tag{1}$$

The profit of the farmer cooperative organization is

$$R_f = (W - C)q. \tag{2}$$

The profit of the e-commerce platform is

$$\begin{aligned} R_l &= (p - W)q - g(e) \\ &= (p - W)q - \frac{1}{2}\mathrm{ke}^2. \end{aligned} \tag{3}$$

The supply chain profit is

$$\begin{aligned} R &= R_f + R_l \\ &= (p - C)q - g(e) = (p - C)q - \frac{1}{2}\mathrm{ke}^2. \end{aligned} \tag{4}$$

4. Decision Models of the Agricultural Products for E-Commerce Supply Chain Based on Revenue-Sharing Contract

There are two decision-making models for the supply chain: decentralized decision-making model and centralized decision-making model. For the decentralized decision-making model, the e-commerce platform decides the selling price and brand promotion effort, and the farmer cooperative organization decides the wholesale price. For the centralized decision-making model, the e-commerce platform and the farmer cooperative organization work together to decide the selling price and brand promotion effort.

Table 2: Research model symbols and descriptions.

Symbol	Meaning
D	Market demand for the product
D_0	Market base demand for the product
a	The elasticity coefficient of market demand to price
b	The elasticity coefficient of market demand to brand promotion effort
p	Selling price of the product
α	Proportion of the e-commerce platform sharing its own revenue
e	Brand promotion effort of the e-commerce platform
C	Unit planting cost of the agricultural product
q	Order quantity of e-commerce platform
k	Sensitivity coefficient of the brand promotion effort of the e-commerce platform
W	Unit wholesale price of the agricultural product
β	The proportion of the brand promotion cost borne by the e-commerce platform

4.1. The Profit Model for the Decentralized Decision Making. Due to the improvement of the bargaining power of farmers' cooperatives, farmers' cooperatives can play a leading role in the agricultural product supply chain, and e-commerce platforms are followers. The farmer cooperative organization determines the wholesale price W. The e-commerce platform determines its brand promotion effort e and selling price p of the agricultural product to meet the market demand.

Under decentralized decision making, the e-commerce platform and the farmer cooperative organization make decisions based on maximizing their interests. First, the e-commerce platform determines the selling price of agricultural products and brand promotion efforts based on the information it possesses. Then, farmers' cooperatives determine the wholesale price of agricultural products based on market information.

Thus, the objective functions of the e-commerce platform and the farmer cooperative organization are as follows:

$$\begin{cases} \max R_f = (W - C)(D_0 - ap + be), \\ \max R_l = (p - W)(D_0 - \mathrm{ap} + \mathrm{be}) - \dfrac{1}{2}\mathrm{ke}^2. \end{cases} \tag{5}$$

The inverse solution method is used to solve the problem. The optimal profit for various decision variables, e-commerce platforms, farmer cooperatives, and the overall system is

$$\begin{aligned} p_1^* &= \frac{\left(3\mathrm{ak} - b^2\right)D_0 + a\left(\mathrm{ak} - b^2\right)C}{2a\left(2\mathrm{ak} - b^2\right)}, \\ e_1^* &= \frac{b(D_0 - aC)}{2\left(2\mathrm{ak} - b^2\right)}, \\ q_1^* &= \frac{ak(D_0 - aC)}{2\left(2\mathrm{ak} - b^2\right)}, \\ R_{l1}^* &= \frac{k(D_0 - aC)^2}{8\left(2\mathrm{ak} - b^2\right)}, \\ R_{f1}^* &= \frac{k(D_0 - aC)^2}{4\left(2\mathrm{ak} - b^2\right)}, \\ R_1^* &= \frac{3k(D_0 - aC)^2}{8\left(2\mathrm{ak} - b^2\right)}. \end{aligned} \tag{6}$$

4.2. The Profit Model for the Centralized Decision Making. Centralized decision making is to regard the e-commerce platform and the farmer cooperative organization as a consortium, and the profit maximization decision is made from the whole consortium. Then,

$$\begin{aligned} R &= (p - C)q - \frac{1}{2}\mathrm{ke}^2 \\ &= (p - C)\left(D_0 - ap + be\right) - \frac{1}{2}\mathrm{ke}^2. \end{aligned} \tag{7}$$

Using the optimal decision principle, the supply chain decision variables and profits are

$$\begin{aligned} p_2^* &= \frac{kD_0 + \left(\mathrm{ak} - b^2\right)C}{2\mathrm{ak} - b^2}, \\ e_2^* &= \frac{b(D_0 - aC)}{2\mathrm{ak} - b^2}, \\ q_2^* &= \frac{ak(D_0 - aC)}{2\mathrm{ak} - b^2}, \\ R_2^* &= \frac{k(D_0 - aC)^2}{2\left(2\mathrm{ak} - b^2\right)}. \end{aligned} \tag{8}$$

4.3. Comparative Analysis of the Two Decision-Making Models. The decision variables of the two decision-making models are shown in Table 3.

Comparing the two decision models in Table 3, we can draw the following conclusions: $q_2^* = 2q_1^*$, $e_2^* = 2e_1^*$, $R_2^* = 4/3R_1^*$, and $R_{f1}^* = 2R_{l1}^*$.

5. The Design of Contract Coordination Mechanism

In this research setting, the overall profit of the supply chain under centralized decision making is significantly higher than that under decentralized decision making. Therefore, it is necessary to reach a particular contract agreement to ensure both parties have profits under centralized decision making, not less than the individual profit under decentralized decision making.

Table 3: Variable values and profits of different decision-making models.

Parameter	Decentralized decision making	Centralized decision making
e	$b(D_0 - aC)/2(2ak - b^2)$	$b(D_0 - aC)/2(2ak - b^2)$
p	$(3\mathrm{ak} - b^2)D_0 + a(\mathrm{ak} - b^2)C/2a(2ak - b^2)$	$kD_0 + (\mathrm{ak} - b^2)C/2\mathrm{ak} - b^2$
q	$\mathrm{ak}(D_0 - aC)/2(2ak - b^2)$	$\mathrm{ak}(D_0 - aC)/2\mathrm{ak} - b^2$
W	$D_0 + aC/2a$	—
R_f	$k(D_0 - aC)^2/4(2\mathrm{ak} - b^2)$	—
R_l	$k(D_0 - aC)^2/8(2\mathrm{ak} - b^2)$	—
R	$3k(D_0 - aC)^2/8(2\mathrm{ak} - b^2)$	$k(D_0 - aC)^2/2(2\mathrm{ak} - b^2)$

5.1. Profit Coordination Scope of the Supply Chain. The basic principle of profit coordination between the e-commerce platform and the farmer cooperative organization is that both of their profits are not lower than those under decentralized decision making.

Proposition 1. *Under the contract coordination mechanism, the profit ranges of the e-commerce platform and the farmer cooperative organization are*

$$\begin{aligned} \frac{k(D_0 - aC)^2}{8(\mathrm{ak} - b^2)} \le R_l \le \frac{k(D_0 - aC)^2}{4(\mathrm{ak} - b^2)}, \\ \frac{k(D_0 - aC)^2}{4(2\mathrm{ak} - b^2)} \le R_f \le \frac{3k(D_0 - aC)^2}{8(2\mathrm{ak} - b^2)}. \end{aligned} \tag{9}$$

Proof. The purpose of contract coordination between the e-commerce platform and the farmer cooperative organization is to make the sum of the individual profit after the coordination achieve the effect of centralized decision making, and the individual profit is not lower than the individual profit in decentralized decision making. So,

$$\begin{aligned} R_f + R_l = \frac{k(D_0 - aC)^2}{2(2\mathrm{ak} - b^2)}, \\ R_l \ge \frac{k(D_0 - aC)^2}{8(2\mathrm{ak} - b^2)}, \\ R_f \ge \frac{k(D_0 - aC)^2}{4(2\mathrm{ak} - b^2)}. \end{aligned} \tag{10}$$

Then,

$$\begin{aligned} \frac{k(D_0 - aC)^2}{8(\mathrm{ak} - b^2)} \le R_l \le \frac{k(D_0 - aC)^2}{4(\mathrm{ak} - b^2)}, \\ \frac{k(D_0 - aC)^2}{4(2\mathrm{ak} - b^2)} \le R_f \le \frac{3k(D_0 - aC)^2}{8(2\mathrm{ak} - b^2)}. \end{aligned} \tag{11}$$

□

5.2. Supply Chain Coordination Based on Revenue Sharing + Cost Sharing + Wholesale Price Discount

Proposition 2. *Assume that the e-commerce platform transfers part of the profits to farmers' cooperatives, and the proportion is* $1 - \alpha$. *Meanwhile, the farmers' cooperatives bear part of the cost of agricultural product promotion, and the proportion is* β. *When the relationship between variables meets three conditions, which are* $\alpha = \beta$, $W = \alpha C$, *and* $1/4 \le \alpha \le 1/2$, *the coordination of the supply chain can be realized based on revenue sharing + cost sharing + wholesale price discount, and the revenue can be maximized.*

Proof. Assume that the e-commerce platform transfers part of the profits to farmers' cooperatives, and the proportion is $1 - \alpha$. Meanwhile, the farmers' cooperatives bear part of the cost of agricultural product promotion, and the proportion is β. Then, the profits of e-commerce platforms and farmers' cooperatives are as follows.

The profit of the e-commerce platform is

$$R_l = (\alpha p - W)q - \frac{1}{2}\beta \mathrm{ke}^2. \tag{12}$$

The profit of the farmer cooperative organization is

$$R_f = [W - C + (1 - \alpha)p]q - 1/2(1 - \beta)ke^2. \tag{13}$$

The inverse solution method is used to solve the problem. Bring formula (1) into formula (12), and then

$$\begin{aligned} R_l &= (\alpha p - W)q - \frac{1}{2}\beta \mathrm{ke}^2 \\ &= (\alpha p - W)(D_0 - ap + be) - \frac{1}{2}\beta \mathrm{ke}^2, \\ \frac{\partial R_l}{\partial p} &= \alpha(D_0 + \mathrm{be}) + aW - 2a\alpha p, \\ \frac{\partial R_l}{\partial e} &= b(\alpha p - W) - \beta \mathrm{ke}, \\ \frac{\partial^2 R_l}{\partial p^2} &= -2a\alpha < 0, \\ \frac{\partial^2 R_l}{\partial e^2} &= -\beta k < 0. \end{aligned} \tag{14}$$

The corresponding Hessian matrix is $H = \begin{pmatrix} -2a\alpha & b\alpha \\ b\alpha & -\beta k \end{pmatrix}$, and its first-order and second-order master subdeterminants are $|H_1| = -2a\alpha < 0$ and $|H_2| = \alpha(2ak\beta - b^2\alpha)$. When $2ak\beta - b^2\alpha > 0$, the Hessian matrix is negative definite, and there is a unique optimal solution (p, e) making the R_l global maximal.

Let $\partial R_l/\partial p = 0$ and $\partial R_l/\partial e = 0$; then,

$$\begin{aligned} p &= \frac{\alpha(D_0 + be) + aW}{2a\alpha}, \\ e &= \frac{b(\alpha p - W)}{\beta k}. \end{aligned} \tag{15}$$

Combining the above two formulas, formula (16) is obtained:

$$\begin{cases} p_3 = \dfrac{\alpha\beta k D_0 + \left(ak\beta - b^2\alpha\right)W}{\alpha\left(2ak\beta - b^2\alpha\right)}, \\ e_3 = \dfrac{b\left(\alpha D_0 - aW\right)}{2ak\beta - b^2\alpha}. \end{cases} \tag{16}$$

Simultaneously, $p_3 = p_2{}^*$ and $e_3 = e_2{}^*$; then, formula (17) is obtained:

$$\begin{cases} \dfrac{\alpha\beta k D_0 + \left(ak\beta - b^2\alpha\right)W}{\alpha\left(2\mathrm{ak}\beta - b^2\alpha\right)} = \dfrac{kD_0 + \left(\mathrm{ak} - b^2\right)C}{2\mathrm{ak} - b^2}, \\ \dfrac{b\left(\alpha D_0 - aW\right)}{2\mathrm{ak}\beta - b^2\alpha} = \dfrac{b\left(D_0 - aC\right)}{2\mathrm{ak} - b^2}. \end{cases} \tag{17}$$

When $\begin{cases} \alpha = \beta \\ W = \alpha C \end{cases}$, the equation set of formula (17) is satisfied. Then,

$$\begin{aligned} R_{l3}{}^* &= \frac{\alpha k\left(D_0 - aC\right)^2}{2\left(2\mathrm{ak} - b^2\right)} \\ &= \alpha R_2{}^*, \\ R_{f3}{}^* &= \frac{(1-\alpha)k\left(D_0 - aC\right)^2}{2\left(2\mathrm{ak} - b^2\right)} \\ &= (1-\alpha)R_2{}^*. \end{aligned} \tag{18}$$

Because $k(D_0 - aC)^2/8(ak - b^2) \le R_l \le k(D_0 - aC)^2/4(ak - b^2)$, $1/4 \le \alpha \le 1/2$.

For farmers' cooperatives, when achieving supply chain coordination through revenue-sharing contracts, the wholesale price of agricultural products is lower than the cost. At the same time, e-commerce platforms need to transfer most of the profits to farmers' cooperatives to achieve centralized pricing and sales effort levels under decision making. This requires a considerable understanding between both parties, which is difficult. □

5.3. Supply Chain Coordination Based on Contracted Wholesale Price. The contract coordination principle based on the wholesale price of agricultural products is as follows. On the one hand, the farmer cooperative organization and the e-commerce platform reach a consensus on the selling price of the agricultural product and the brand promotion effort paid by the e-commerce platform through contract, to maximize the overall profit of the supply chain. On the other hand, both parties agree on the wholesale price of the agricultural product to ensure the individual profit is not lower than their respective profits under decentralized decision making. The core of coordination is the scope of the wholesale price of the farmer cooperative organization. The specific coordination mechanism is as follows.

Proposition 3. *Under centralized decision making in setting the selling price and the brand promotion effort, when* $D_0 + 3aC/4a \le W \le 3D_0 + 5aC/8a$, *the supply chain can achieve profit coordination.*

Proof. When $p = kD_0 + (ak - b^2)C/2\mathrm{ak} - b^2$ and $e = b(D_0 - aC)/2ak - b_2$, then $q = \mathrm{ak}(D_0 - aC)/2\mathrm{ak} - b^2$ and $R_f = (W - C)q = (W - C)\mathrm{ak}(D_0 - aC)/2\mathrm{ak} - b^2$.

Because $k(D_0 - aC)^2/4(2ak - b^2) \le R_f \le 3k(D_0 - aC)^2/8(2ak - b^2)$,

$$\frac{D_0 + 3aC}{4a} \le W \le \frac{3D_0 + 5aC}{8a}. \tag{19}$$

Under the contract coordination scheme, it is feasible to negotiate and determine the wholesale price of agricultural products to achieve coordination of the agricultural supply chain in reality [18]. □

6. Numerical Analysis

This study assumes that the e-commerce platform only sells one agricultural product. Referring to the practice of Yang et al. [54], the allocation of various parameters is as follows: $D_0 = 200$, $a = 6$, and $b = 5$. The demand function of that agricultural product is $D = 200 - 6p + 5e$. $k = 8$, and the brand promotion effort, the cost paid by the e-commerce platform, is $g(e) = 4e^2$. Let $C = 10$ \$. Due to the balance of supply and demand, there will be $q = D = 200 - 6p + 5e$.

6.1. Analysis Based on Revenue Sharing + Cost Sharing + Wholesale Price Discount Coordination. When coordinating through revenue sharing + cost sharing + wholesale price, $1/4 \le \alpha \le 1/2$. The wholesale price depends on the results of the negotiation and game. The individual profit of each party under different wholesale prices is shown in Table 4 and Figure 1.

Table 4 and Figure 1 show that the essence of coordination based on revenue sharing + cost sharing + wholesale price discount is the secondary distribution of revenue and cost. The smaller the α, the greater the proportion of revenue shared by the e-commerce platform, the lower the profit of the e-commerce platform, and the higher the profit of the farmer cooperative organization, and vice versa. When the

Table 4: Supply chain variables and profits under different values.

Parameter	Profit coordination					
e			9.86			
p			25.77			
q			94.65			
α	0.25	0.3	0.35	0.4	0.45	0.5
W	5.42	6.5	7.58	8.67	9.75	10.84
R_l	275.94	331.13	386.31	441.5	496.69	551.87
R_f	827.81	772.62	717.44	662.25	607.06	551.88
R	1103.75	1103.75	1103.75	1103.75	1103.75	1103.75

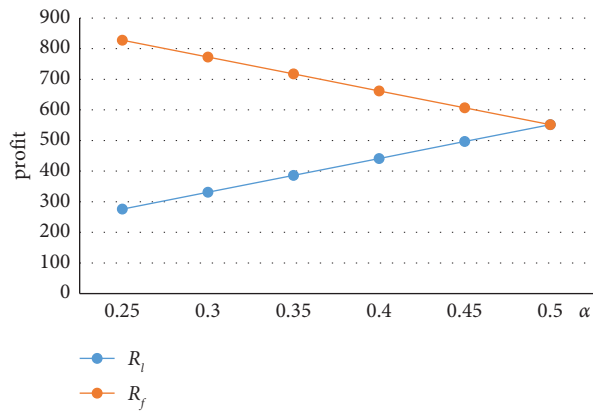

Figure 1: Revenue sharing + cost sharing + wholesale price discount coordination.

proportion of profits transferred by e-commerce platforms decreases by 0.05, the profits of e-commerce platforms increase by 55.19, and the profits of farmers' cooperatives decrease by 55.19.

6.2. Analysis Based on the Contracted Agricultural Wholesale Price. According to the above example, according to formulas (7) and (8), the profit coordination range of the farmer cooperative organization is [552.22, 828.09], and the profit coordination range of the e-commerce platform is [275.66, 551.53]. Bring the above values into formula (18), and the coordination range of wholesale price of agricultural products is $15.83 \le W \le 18.75$.

The specific coordination results depend on both parties' negotiation and game results. The individual profit of each party under different wholesale prices is shown in Table 5 and Figure 2.

Table 5 and Figure 2 show that the higher the wholesale price of the agricultural product, the higher the profit of the farmer cooperative organization and the lower the profit of the e-commerce platform. The specific pricing of the agricultural product depends on the relative negotiation advantages of the farmer cooperative organization. The stronger the leading ability of the farmer cooperative organization is and the higher the wholesale price of the agricultural product is, the more profit the farmer cooperative organization will make. When the wholesale price of agricultural products increases by 0.5, the profits of farmers' cooperatives increase by 47.33, and the profits of e-commerce platforms decrease by 47.33.

7. Discussion, Conclusions, and Recommendations

7.1. Conclusions. Under the background of rural revitalization, in order to reduce the mismatch between the supply and demand of online shopping agricultural products and promote the collaborative cooperation between e-commerce platforms and farmer cooperative organizations, this study shows how to achieve win-win cooperation between e-commerce platforms and farmer cooperative organizations. Taking an agricultural product as an example, this study compares the results of decentralized decision-making model and centralized decision-making models, for which the farmer cooperative organization is the prominent leader, and the e-commerce platform is the follower.

Through comparative analysis, it finds that when the e-commerce platform and the farmer cooperative organization make a centralized decision, the product sales are twice than decentralized decision, and the overall profit of the supply chain is 4/3 times higher than the decentralized decision. Therefore, achieving the effect of centralized decision making through cooperation is the best decision plan for both parties. This paper provides two coordination schemes. First, the "revenue sharing + cost sharing + wholesale price discount" coordination plan was adopted. Second, the two sides agreed on the contract coordination plan for the wholesale price of agricultural products.

This research has been verified by case analysis. The decision of cooperation contract scheme between e-commerce platform and farmers' cooperative depends on the comparative advantages of e-commerce platform and farmers' cooperative in negotiation and game. This provides a particular theoretical reference for the selection of cooperation schemes between the two parties in practice and also provides a theoretical basis for the follow-up research on the supply chain contract coordination of fresh agricultural products.

7.2. Theoretical Contributions

7.2.1. Agricultural Product Supply Chain Coordination. Previous studies on supply chain coordination of agricultural products mainly focused on consumer demand and agricultural product logistics, and few studies paid attention to agricultural product brand promotion efforts paid by the e-commerce platform. In addition, most research on supply chain coordination is dominated by e-commerce platforms

Table 5: Wholesale price coordination of agricultural products.

Parameter	Profit coordination					
e			9.86			
p			25.77			
q			94.65			
W	16	16.5	17	17.5	18	18.5
R_l	535.85	488.52	441.2	393.87	346.55	299.22
R_f	567.9	615.23	662.55	709.88	757.2	804.53
R	1103.75	1103.75	1103.75	1103.75	1103.75	1103.75

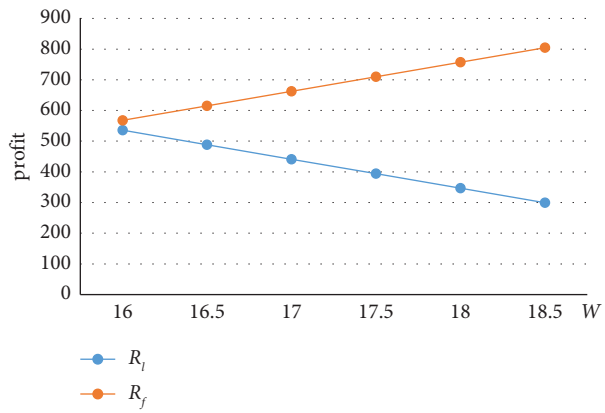

Figure 2: Wholesale price coordination of agricultural products.

and rarely from the perspective of farmer cooperative organizations. This study stands on the perspective of farmer cooperative organizations and analyzes the impact of the agricultural product brand promotion effort on sales volume and profits among supply chain members. The results of this study indicate that the sales volume of agricultural products is affected by brand promotion efforts, which is consistent with the reality that consumers' online purchase of agricultural products is often affected by agricultural product brands promoted on online platforms.

7.2.2. Contract Coordination Mechanism. Previous studies on the contract coordination mechanism of raw agricultural products supply chains mainly focused on consumer demand, the freshness of agricultural products, and the logistics service level. This study focuses on the brand promotion effort of agricultural products. Previous contract coordination strategies mainly focused on revenue-sharing and cost-sharing principles or repurchase contracts. This study focuses on the contract coordination of agricultural products' online shopping supply chain composed of farmer cooperatives and e-commerce platforms and designs two contract coordination schemes. One is a coordination strategy based on revenue-sharing principle, and the other is a wholesale price coordination strategy for agricultural products. This study shows how these two coordination strategies can achieve win-win cooperation in the supply chain.

This study contributes to our knowledge in understanding (1) how the development of e-commerce of agricultural products is affected by the marketing strength of agricultural product brands by e-commerce platforms and (2) how wholesale price setting affects the supply chain coordination based on the principle of revenue sharing and cost sharing.

7.3. Practical Implications. From the example analysis, when an e-commerce platform cooperates with a farmer cooperative organization for centralized decision making, a slight reduction in selling price can double the sales volume of the agricultural product. If the level of brand promotion effort is doubled, the overall profit of the supply chain can be increased by 33.33%. Therefore, e-commerce platforms and farmer cooperative organizations should establish alliances to expand sales by reducing the selling price of agricultural products and increasing brand promotion efforts to maximize the supply chains' overall profits. Internally, through coordination methods such as income-sharing contracts and adjusting the wholesale price of agricultural products, a win-win situation can be achieved in which the individual profit of each party can be increased. Some specific recommendations are provided as follows.

7.3.1. Strengthening the Investment in Brand Promotion. The online channel sales of grocery products are not limited by time, place, and region. However, agricultural products are often limited by season or timeliness. Therefore, the promotion of agricultural products is essential to push the sales volume quickly because the online sales of agricultural products are largely affected by brand promotion. The e-commerce platforms should increase investment in the brand promotion of agricultural products, establish a particular column for sales of agricultural products, and carry out extensive publicity. The e-commerce platforms can use short videos to promote products and hire celebrities to show how to consume the products.

7.3.2. Strengthening the Contract Management. This study shows that setting the wholesale prices of agricultural products is essential under the centralized decision-making method. The adjustment of the wholesale prices depends on the specific cooperation schemes between e-commerce platforms and farmer cooperative organizations. It is necessary to strengthen contract management by constraining the behavior of both parties through contracts, increasing the punishment of breach costs, and achieving the stability and sustainability of contracts. The farmers can increase their income, get rich, and promote the release of rural domestic demand potential only in this way. Furthermore, it has important strategic significance for promoting rural revitalization.

7.4. Research Limitations and Future Research Directions. This study has the following limitations. The demand function for the agricultural product was considered to be a simple linear relationship with price and brand promotion effort. It did not consider other factors into account. Further studies are recommended to add other factors such as logistics services. The demand function for agricultural products may have very complex nonlinear relationships. In contract coordination, it is not limited to the coordination of the wholesale price. Researchers can consider various contract coordination schemes.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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References

[1] W. Chanti and Q. Youzhen, "A nonlinear empirical analysis on influence factor of circulation efficiency," *Discrete & Continuous Dynamical Systems- S*, vol. 12, no. 4-5, pp. 929–940, 2019.

[2] mofcom, "Ministry of commerce; prc," 2020, http://english.mofcom.gov.cn/article/newsrelease/press/202202/20220203278924.shtml.

[3] A. Chlebicka and M. Pietrzak, "Size of membership and survival patterns of producers' organizations in agriculture-social aspects based on evidence from Poland," *Sustainability*, vol. 10, no. 7, p. 2293, 2018.

[4] A. Kar, P. Kumar, P. Prakash et al., "Doubling farmers' income in Delhi state: an introspection," *Indian Journal of Agricultural Sciences*, vol. 90, no. 8, pp. 1488–1496, 2020.

[5] J. Schwabe, C. V. Nguyen, and M. Hassler, "The challenge of upgrading white shrimp production in central Vietnam and the potential of farming cooperatives," *Die Erde*, vol. 152, pp. 51–64, 2021.

[6] M. L. Li, S. M. Zhang, and N. Khan, "Do farmers' professional cooperatives improve agricultural technical efficiency? Evidence using a national-level dataset of China," *Annals of Public and Cooperative Economics*, vol. 10, 2023.

[7] M. D. R. Neves, F. D. Silva, C. O. de Freitas, and M. J. Braga, "The role of cooperatives in Brazilian agricultural production," *Agriculture-Basel*, vol. 11, p. 15, 2021.

[8] Q. F. Hu, Q. Y. Xu, and B. Xu, "Introducing of online channel and management strategy for green agri-food supply chain based on pick-your-own operations," *International Journal of Environmental Research and Public Health*, vol. 16, no. 11, p. 1990, 2019.

[9] A. Ranjan and J. K. Jha, "Pricing and coordination strategies of a dual-channel supply chain considering green quality and sales effort," *Journal of Cleaner Production*, vol. 218, pp. 409–424, 2019.

[10] Y. G. Zhong, I. K. W. Lai, F. F. Guo, and H. J. Tang, "Research on government subsidy strategies for the development of agricultural products E-commerce," *Agriculture*, vol. 11, p. 1152, 2021.

[11] A. M. Klepacka, W. J. Florkowski, and C. Revoredo-Giha, "Can family farms depend on price information? Testing butter and curd price integration in Poland," *Agriculture*, vol. 11, no. 5, p. 434, 2021.

[12] Z. M. Zhang, H. Zhao, and X. Y. Zeng, "Government subsidies and online branding for agricultural products," *Evolutionary Intelligence*, vol. 15, 2021.

[13] S. Z. Bai and X. L. Jia, "Agricultural supply chain financing strategies under the impact of risk attitudes," *Sustainability*, vol. 14, p. 8787, 2022.

[14] N. N. Wan, L. Li, X. Z. Wu, and J. C. Fan, "Coordination of a fresh agricultural product supply chain with option contract under cost and loss disruptions," *PLoS One*, vol. 16, no. 6, Article ID e0252960, 2021.

[15] Y. Cao, L. Tao, K. Wu, and G. Y. Wan, "Coordinating joint greening efforts in an agri-food supply chain with environmentally sensitive demand," *Journal of Cleaner Production*, vol. 277, Article ID 123883, 2020.

[16] F. Qiu, Q. F. Hu, and B. Xu, "Fresh agricultural products supply chain coordination and volume loss reduction based on strategic consumer," *International Journal of Environmental Research and Public Health*, vol. 17, no. 21, p. 7915, 2020.

[17] Y. S. Huang, Y. C. Hsu, and C. C. Fang, "A study on contractual agreements in supply chains of agricultural produce," *International Journal of Production Research*, vol. 57, no. 11, pp. 3766–3783, 2019.

[18] Z. L. Song and S. W. He, "Contract coordination of new fresh produce three-layer supply chain," *Industrial Management & Data Systems*, vol. 119, no. 1, pp. 148–169, 2019.

[19] X. L. Sheng, "Research on cold chain risk control of fresh agricultural products e-commerce from the perspective of green ecological agriculture," *Fresenius Environmental Bulletin*, vol. 30, pp. 7946–7953, 2021.

[20] G. Behzadi, M. J. O'Sullivan, T. L. Olsen, and A. Zhang, "Agribusiness supply chain risk management: a review of quantitative decision models," *Omega*, vol. 79, pp. 21–42, 2018.

[21] J. H. Hao, J. Bijman, C. Gardebroek, N. Heerink, W. Heijman, and X. X. Huo, "Cooperative membership and farmers' choice of marketing channels- evidence from apple farmers in Shaanxi and Shandong Provinces, China," *Food Policy*, vol. 74, pp. 53–64, 2018.

[22] B. Z. Niu, D. L. Jin, and X. J. Pu, "Coordination of channel members' efforts and utilities in contract farming operations," *European Journal of Operational Research*, vol. 255, no. 3, pp. 869–883, 2016.

[23] B. Minten, T. Assefa, and K. Hirvonen, "Can agricultural traders be trusted? Evidence from coffee in Ethiopia," *World Development*, vol. 90, pp. 77–88, 2017.

[24] D. M. Houessou, B. Sonneveld, A. K. N. Aoudji et al., "How to transition from cooperations to cooperatives: a case study of the factors impacting the organization of urban gardeners in Benin," *Sustainability*, vol. 11, no. 17, p. 4528, 2019.

[25] Y. P. Jiang, K. R. Li, S. F. Chen, X. L. Fu, S. Y. Feng, and Z. S. Zhuang, "A sustainable agricultural supply chain considering substituting organic manure for chemical fertilizer," *Sustainable Production and Consumption*, vol. 29, pp. 432–446, 2022.

[26] L. Yang and R. H. Tang, "Comparisons of sales modes for a fresh product supply chain with freshness-keeping effort," *Transportation Research Part E: Logistics and Transportation Review*, vol. 125, pp. 425–448, 2019.

[27] Y. J. Zhang, F. Rong, and Z. Wang, "Research on cold chain logistic service pricing-based on tripartite Stackelberg game," *Neural Computing & Applications*, vol. 32, no. 1, pp. 213–222, 2020.

[28] Y. L. Yu and T. J. Xiao, "Pricing and cold-chain service level decisions in a fresh agri-products supply chain with logistics outsourcing," *Computers & Industrial Engineering*, vol. 111, pp. 56–66, 2017.

[29] Y. T. Li, C. Q. Tan, W. H. Ip, and C. Wu, "Dynamic blockchain adoption for freshness-keeping in the fresh agricultural product supply chain," *Expert Systems with Applications*, vol. 217, Article ID 119494, 2023.

[30] S. S. Hu, S. Huang, and X. H. Qin, "Exploring blockchain-supported authentication based on online and offline business in organic agricultural supply chain," *Computers & Industrial Engineering*, vol. 173, Article ID 108738, 2022.

[31] Z. J. Zhu, Y. H. Bai, W. H. Dai, D. Liu, and Y. Hu, "Quality of e-commerce agricultural products and the safety of the ecological environment of the origin based on 5g internet of things technology," *Environmental Technology & Innovation*, vol. 22, 2021.

[32] M. Luo, G. H. Zhou, and W. Wei, "Study of the game model of E-commerce information sharing in an agricultural product supply chain based on fuzzy big data and LSGDM," *Technological Forecasting and Social Change*, vol. 172, 2021.

[33] W. Huang, P. Q. Hu, F. S. Tsai, Y. K. Liu, and Y. Huang, "Smart sales empower small farmers: an integrated matching method between suppliers and consumers based on the information axiom," *Sustainability*, vol. 14, no. 24, Article ID 16937, 2022.

[34] Y. Q. Xu, J. Wang, and K. Y. Cao, "Interaction between joining platform blockchain technology and channel encroachment for fresh agricultural product firms," *International Transactions in Operational Research*, vol. 8, 2023.

[35] Z. J. Xie, H. Kong, and B. Wang, "Dual-chain blockchain in agricultural E-commerce information traceability considering the viniar algorithm," *Scientific Programming*, vol. 2022, Article ID 2604216, 10 pages, 2022.

[36] M. Alkahtani, Q. S. Khalid, M. Jalees, M. Omair, G. Hussain, and C. I. Pruncu, "E-agricultural supply chain management coupled with blockchain effect and cooperative strategies," *Sustainability*, vol. 13, no. 2, p. 816, 2021.

[37] B. Z. Niu, J. Dong, Z. P. Dai, and J. Y. Jin, "Market expansion vs. intensified competition: overseas supplier's adoption of blockchain in a cross-border agricultural supply chain," *Electronic Commerce Research and Applications*, vol. 51, Article ID 101113, 2022.

[38] X. P. Han, S. Z. Bai, and H. Yu, "Pre-sale strategy for fresh agricultural products under the consideration of logistics services," *IEEE Access*, vol. 9, pp. 127742–127752, 2021.

[39] J. J. Ren, H. X. Li, M. M. Zhang, and C. Wu, "Massive-scale graph mining for e-commerce cold chain analysis and optimization," *Future Generation Computer Systems*, vol. 125, pp. 526–531, 2021.

[40] J. W. Gao, Z. L. Cui, H. J. Li, and R. R. Jia, "Optimization and coordination of the fresh agricultural product supply chain considering the freshness-keeping effort and information sharing," *Mathematics*, vol. 11, 2023.

[41] F. F. Guo, T. Zhang, X. Q. Huang, and Y. G. Zhong, "Government subsidy strategies considering greenness on agricultural product E-commerce supply chain," *Mathematics*, vol. 11, no. 7, p. 1662, 2023.

[42] P. Liu, Y. Long, H. C. Song, and Y. D. He, "Investment decision and coordination of green agri-food supply chain considering information service based on blockchain and big data," *Journal of Cleaner Production*, vol. 277, Article ID 123646, 2020.

[43] C. E. Etumnu, K. Foster, N. O. Widmar, J. L. Lusk, and D. L. Ortega, "Does the distribution of ratings affect online grocery sales? Evidence from Amazon," *Agribusiness*, vol. 36, no. 4, pp. 501–521, 2020.

[44] M. Li, L. N. He, G. C. Yang, and Z. Lian, "Profit-sharing contracts for fresh agricultural products supply chain considering spatio-temporal costs," *Sustainability*, vol. 14, no. 4, p. 2315, 2022.

[45] Q. Yang, L. Xiong, Y. F. Li, Q. Chen, Y. J. Yu, and J. Y. Wang, "Contract coordination of fresh agri-product supply chain under O2O model," *Sustainability*, vol. 14, p. 8771, 2022.

[46] B. Yan, X. H. Wu, B. Ye, and Y. W. Zhang, "Three-level supply chain coordination of fresh agricultural products in the Internet of Things," *Industrial Management & Data Systems*, vol. 117, no. 9, pp. 1842–1865, 2017.

[47] Y. Yang, G. X. Yao, and X. R. Fan, "Cooperative production behavior of fresh agricultural product suppliers under regional product standardization construction," *Complexity*, vol. 2022, Article ID 7993599, 14 pages, 2022.

[48] A. Nagurney, D. Besik, and M. Yu, "Dynamics of quality as a strategic variable in complex food supply chain network competition: the case of fresh produce," *Chaos*, vol. 28, no. 4, Article ID 043124, 2018.

[49] Y. G. Zhong, F. F. Guo, H. J. Tang, and X. M. Chen, "Research on coordination complexity of E-commerce logistics service supply chain," *Complexity*, vol. 2020, 21 pages, 2020.

[50] W. P. P. Soe, M. Moritaka, and S. Fukuda, "An analysis of the factors influencing marketing channel choice by paddy rice farmers in Myanmar," *Journal of the Faculty of Agriculture, Kyushu University*, vol. 60, no. 2, pp. 535–542, 2015.

[51] D. Ghosh and J. Shah, "A comparative analysis of greening policies across supply chain structures," *International Journal of Production Economics*, vol. 135, no. 2, pp. 568–583, 2012.

[52] J. Zhao and J. Wei, "The coordinating contracts for a fuzzy supply chain with effort and price dependent demand," *Applied Mathematical Modelling*, vol. 38, no. 9-10, pp. 2476–2489, 2014.

[53] Z. L. Liu, T. D. Anderson, and J. M. Cruz, "Consumer environmental awareness and competition in two-stage supply chains," *European Journal of Operational Research*, vol. 218, no. 3, pp. 602–613, 2012.

[54] L. Yang, Y. J. Hu, and L. J. Huang, "Collecting mode selection in a remanufacturing supply chain under cap-and-trade regulation," *European Journal of Operational Research*, vol. 287, no. 2, pp. 480–496, 2020.