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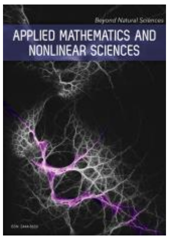

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Developing a Dynamic Marketing Channel Model for Agricultural Cooperatives in the New Media Economy Using the Power of the Internet of Things

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Abstract

The marketing channel is the lifeline of agricultural product circulation and marketing. Multi-level and multi-channel smooth circulation of agricultural products is an important way for agricultural cooperatives to realize the value of their goal. This paper builds an agricultural Internet of Things service system to lay an informatization foundation for the development of dynamic marketing channels of “new media platform + agricultural cooperatives”. With the use of new media platforms as an operational mode and the marketing strategy of agricultural cooperatives as guidance, the marketing effectiveness of agricultural products can be improved. Adopting Internet thinking and innovation trends, comprehending the characteristics of new media marketing, and encouraging collaboration between new media platforms and agricultural cooperatives. Based on 28,450 agricultural cooperatives in China, the marketing channel mode selection and characteristic data were analyzed, and it was found that among the 2,617 cooperatives using new media platforms for channel marketing, the product price fluctuation was between 0 and 10%, and the difficulty of product sales was stable in the interval of [0,40], which indicated that the new media marketing channel could make the price of agricultural products stable and easier to sell. Evolutionary game analysis found that the choice of cooperation or non-cooperation between agricultural cooperatives and new media platforms is related to the coefficient of benefit analysis, the coefficient of cooperation cost, and the liquidated damages of the cooperation between the two parties. Therefore, in order to improve the intensity of cooperation between new media platforms and agricultural cooperatives, improvements should be made in terms of benefits, costs, and liquidated damages.

Keywords: Agricultural cooperatives; Internet of Things; New media platform; Marketing channels; Evolutionary game.
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1 Introduction

Agricultural cooperatives are forms of economic organization formed voluntarily by a certain number of farmers with the purpose of serving the farmers' economy and expanding their income. The history of agricultural cooperatives can be traced back to the ancient agricultural mutual aid organizations, but the real sense of agricultural cooperatives originated in the process of European agricultural industrialization [1-4]. With the progress of agricultural science and technology and the development of rural collective economy, agricultural cooperatives have been growing and popularized worldwide [5-6].

As a form of economic organization with both traditional and modern characteristics, agricultural cooperatives play an important role in promoting the development of farmers' collective economy. By effectively integrating rural resources, they improve farmers' economic income and quality of life and promote the process of agricultural modernization [7-10]. Cooperatives have improved the market competitiveness of agricultural products through the integration of centralized production, processing, and marketing of agricultural products and have played a positive role in promoting the increase of farmers' income and the sustainable development of agriculture [11-14]. In the era of the Internet of Things, the choice of marketing channels and the development of marketing strategies for agricultural cooperatives have an important impact on the sales and development of agricultural products [15-17]. Both traditional and modernized marketing channels should be selected according to the characteristics of agricultural products and the needs of the target market. In the implementation of marketing strategies, branding, market segmentation, and the development of origin branding will become an effective means to improve product competitiveness and market share [18-21].

This study establishes an agricultural Internet of Things application service system to realize the diverse characteristics of agricultural marketing. Under the agricultural Internet of Things service system, the operation mode of "new media platform + agricultural cooperative" is constructed to realize the "bipolar dialogue" between consumers and producers based on the principal-agent theory and virtual contract and to give new characteristics to producers (farmers), consumers and the new media platform. It provides new characteristics to producers (farmers), consumers, and the new media platform. At the same time, in the dynamic marketing channel, the new media platform's information processing ability is utilized to decompose, integrate, and restore orders, thereby maximizing the income of agricultural cooperatives. Five decision-making modes of centralized decision-making, fully decentralized decision-making, farmer, decentralized and centralized cooperation are constructed, and Stankelberg game analysis is carried out to simulate the effectiveness of the use of agricultural cooperatives and the new media channel mode under the five different decision-making modes.

2 Dynamic marketing channel models for agricultural cooperatives in the new media

2.1 Agricultural IoT service system

The Internet of Things is a technical system that combines intelligent technology with information technology, hardware with software, and hardware with hardware, with the goal of facilitating communication between intelligent devices and people. At present, the Internet of Things has three main functions, one of which is to use a variety of information detection facilities to collect comprehensive data collection, and then use a limited way or wireless way to send the collected data to the analysis terminal. The second function is to transfer data from different regions to other regions through an Internet connection to achieve data interoperability and sharing. The third objective is to intelligently analyze the collected data and enhance automated control. Internet technology can be subdivided into three levels, such as the perception layer, network layer, and application layer.

The Agricultural Internet of Things technology system initially consisted of four major systems: the information acquisition system, transmission system, processing system, and control system. Different systems hold different functions, specifically:

1) The information acquisition system contains a variety of sensors and communication modules, such as temperature sensors, gas composition test sensors, composition content sensors, air measurement sensors, soil moisture sensors, liquid flow sensors, acidity measurement sensors and so on.

2) The information transmission system contains wireless infrared transmission technology, positioning technology, signal transmission technology, wired broadband and so on.

3) The information processing system contains data intelligence analysis technology, computer configuration software, PLC electromechanical controller, microcontroller controller, DDC digital controller and so on.

4) The information control system consists of the control device, an execution device and so on. The operation process of the whole system is that the information processing unit sends commands to the control device, and the control system is responsible for opening or closing the corresponding execution devices, such as temperature lifting devices, irrigation devices, dehumidification devices, etc.

Agricultural Internet of Things service system refers to the comprehensive development of agricultural Internet of Things promotion, animal and plant disease prevention and control, agricultural product quality supervision, and "three-in-one" agricultural public service organizations. Including the establishment of the chief agricultural Internet of Things promotion experts, agricultural Internet of Things instructors as the backbone of the county agricultural Internet of Things Center, townships and townships set up a unified, comprehensive agricultural Internet of Things service center, administrative villages set up a village-level agricultural service station, equipped with 1 ~ 2 village-level agricultural service assistants. At the same time, the establishment of village-level agricultural Internet of Things demonstration centers initially constructed a government-led Internet of Things technology support, the main body of farmers, social participation and horizontal to the side, vertical to the end of the agricultural Internet of Things service system.

2.2 New media marketing

2.2.1 New media matrix system

The so-called new media marketing refers to the method of utilizing new media platforms for marketing campaigns. At the moment of rapid innovation in the information age, marketing methods and approaches are also progressing at the same time, starting from the period of network publicity of interactivity, differentiation, creativity, relevance, experience, etc., and moving towards the period of new media publicity [22]. The main characteristics of new media are manifested in the following four major aspects:

Firstly, it caters to the fragmentation of the social public's demand for entertainment life.

Secondly, it breaks through the time and regional limitations and has real-time and interactivity.

Thirdly, the public has the initiative to obtain new media information.

Fourth, the new media information is more personalized, with a rich market and segmented categories.

The integration of new media channels with traditional specialty agricultural brands in sales content and sales links can reduce the sales cost of specialty agricultural products and make the sales process more convenient, which is in line with the modern purchasing needs of consumers.

New Media Matrix, as the name suggests, is oriented towards consumers by providing more information about enterprises through diverse marketing channels [23]. Increase the influence of corporate brands to achieve a high customer conversion rate and bring customers to a new type of media. And to achieve the final conversion to users, thus realizing the ultimate goal of corporate sustainability and profitability of the new media business model. The new media matrix system is shown in Figure 1, and this paper divides the new media matrix into collaborative, coverage, and joint new media matrixes. The collaborative new media matrix is a term used to describe the use of a new media platform to form a matrix with more accounts for various purposes. To meet the diverse ways of utilizing the new media characteristics of this subject, we will jointly provide services to a new subject.

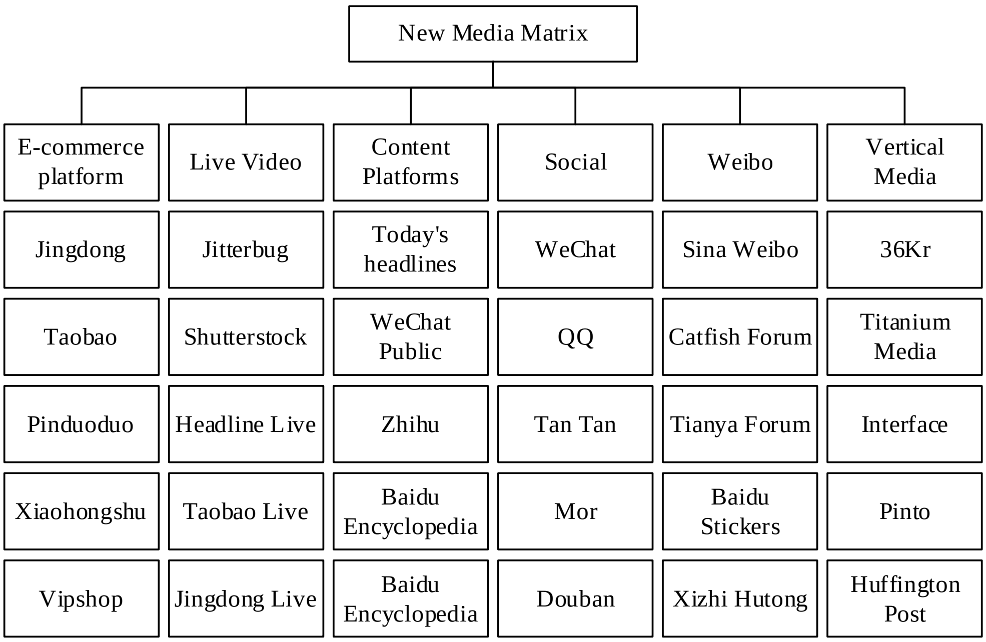

Figure 1. New media matrix system

In most cases, such a matrix is used as a guide to introduce easily convertible (implementable) media platforms to maximize profits. The so-called matrix model is a horizontal, equal, and balanced synthesis of related elements. The vertical organization is connected by numerous equivalent units that ultimately combine horizontally and vertically to form a complete cross-linked matrix model.

2.2.2 New Media Marketing Characteristics

New media marketing will undergo changes due to the rapid development and changes in science and technology. But the purpose of marketing is unified so that the services and products of agricultural cooperatives can attract the perceived identity of consumers, resulting in successful conversion of consumer behavior. Currently, new media marketing is considered to have the following characteristics:

1) Interactivity

Interactivity between online and offline in the process of marketing behavior from the perspective of new media is a unique feature of the Internet era, reflected in the real-time interaction between online enterprises and consumers in the implementation of the marketing process.

2) Popularization

From the perspective of the new media matrix, the popularity of enterprise technology marketing is closely related to the popularity of the Internet. With the gradual impact of mobile information technology on the basic communication tools of people's daily lives, new media technology on the Internet has gradually entered people's lives.

3) Diversity

The diversity of the marketing platform of agricultural products from the perspective of the new media matrix is reflected in the diversified media and carrier forms of the matrix. In the era of rapid development of new media, agricultural cooperatives can use short videos, WeChat soft text and other carriers to establish a variety of communication media to promote consumer attention to marketing information and carry out new media matrix marketing.

4) Refinement

From the perspective of the new media matrix, consumer demand for products is more personalized and refined. After a large number of network expressions in recent years, several agricultural hot case layers have also been produced on the network. However, there are many examples of generalization, and while investigating the reasons, the precision is not very good. Attracting the consumer side can not improve the consumer consumption of "sticky" in the new media agricultural marketing process. The dynamic model of new media marketing customers can be seen in Fig. 2, which shows that agricultural cooperatives must achieve "transformation" and "retention" in "attracting traffic" in the marketing of agricultural products with the help of new media. In the process of new media marketing, agricultural cooperatives must realize "transformation" and "retention" in "attracting traffic". In the new media marketing process, people's demand for agricultural products market, can be utilized by using the current enterprise widely used big data analysis technology. By utilizing big data analytics, agricultural cooperatives can better understand their customers' needs, thus guiding them to tailor their marketing plans to local conditions. And this will prompt people to develop new consumption habits, so as to better meet market demands.

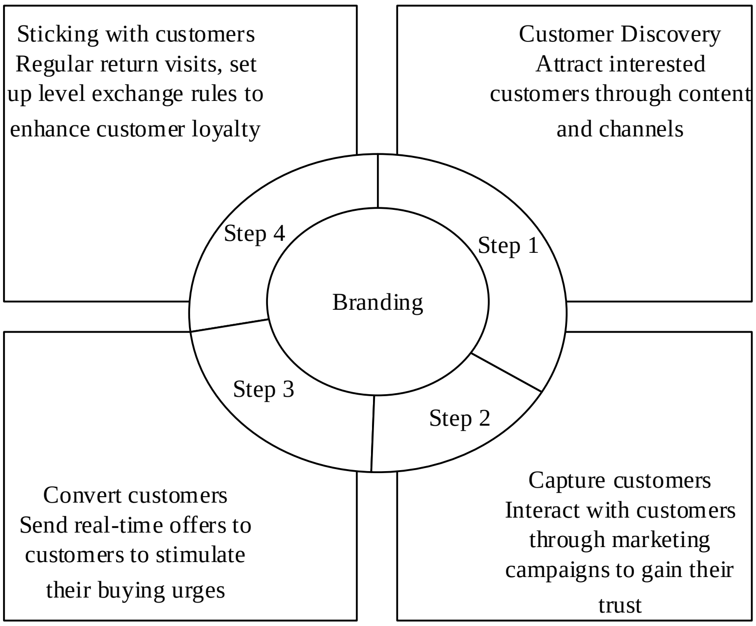

Figure 2. New media Marketing customer dynamic Model

2.3 New Media Dynamic Marketing Channel Models

2.3.1 "New media + agricultural cooperatives" operational model

Under the agricultural Internet of Things service system, to build the operation mode of "new media platform + agricultural cooperatives", it is necessary to start from both farmers and consumers and realize the "bipolar dialogue" between consumers and producers based on the principal-agent theory and virtual contract, and give new characteristics to producers (farmers), consumers and the new media platform. The producers (farmers), consumers, and the new media platform have been given new characteristics. Different from the existing e-commerce model, by reshaping the identities of the three, realizing a new operation mode, playing the role of the new media platform as a supervisor and guarantor, transforming the operation mode of traditional farmers, creating a brand new consumption experience for consumers, and connecting the needs of producers and consumers, the specific operation mode is shown in Figure 3. First, consumers submit order 1 to the new media platform, which decomposes order 1 according to consumer demand and then integrates it into order 2. Then, it is outsourced to agricultural cooperatives to organize production, and the new media platform completes the decomposition of order 2 in the field, and then reduces it to order 1 and distributes it to consumers, finally, through the new media platform to complete the task of financial settlement at both ends.

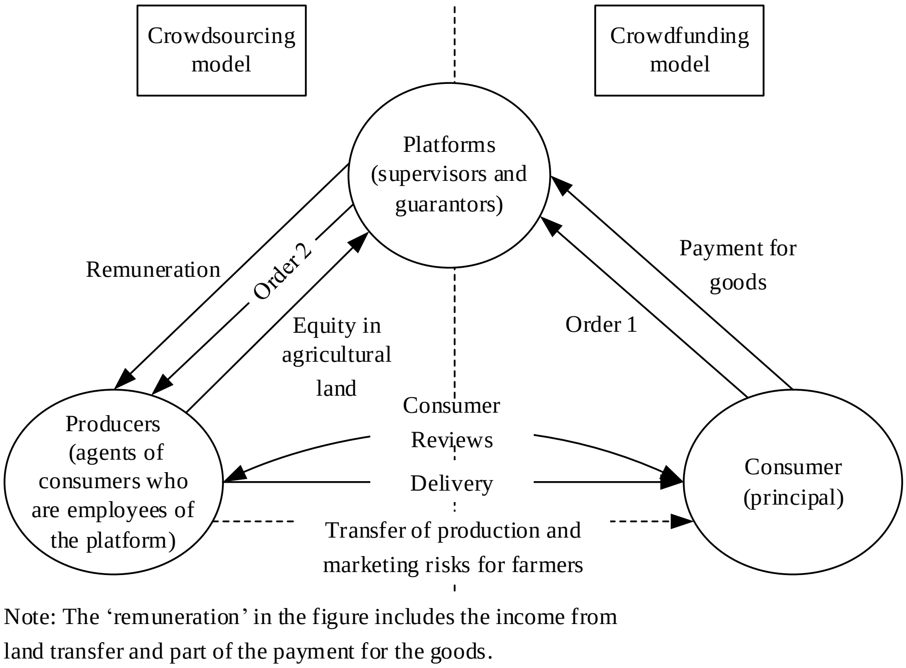

Figure 3. Operation model of "new media platform + agricultural cooperative"

2.3.2 "New Media + Agricultural Cooperatives" Production Methods

Under the agricultural Internet of Things (IoT) service system, the dynamic marketing channel of "new media platform + agricultural cooperatives" utilizes the information processing capability of the new media platform to decompose, integrate and restore orders, which can realize centralized procurement of different from that of brick-and-mortar supermarkets. To achieve large-scale production, batch customization of consumers' personalized needs is done at the same time. Through the production of agricultural cooperatives and the implementation of entrepreneurial management of agricultural cooperatives, the original single farmer planted and managed a variety of crops. After the implementation of enterprise management in agricultural cooperatives, a single farmer can only grow and manage one crop, as shown in Figure 4. This theoretically achieves economies of scale and improves operational efficiency.

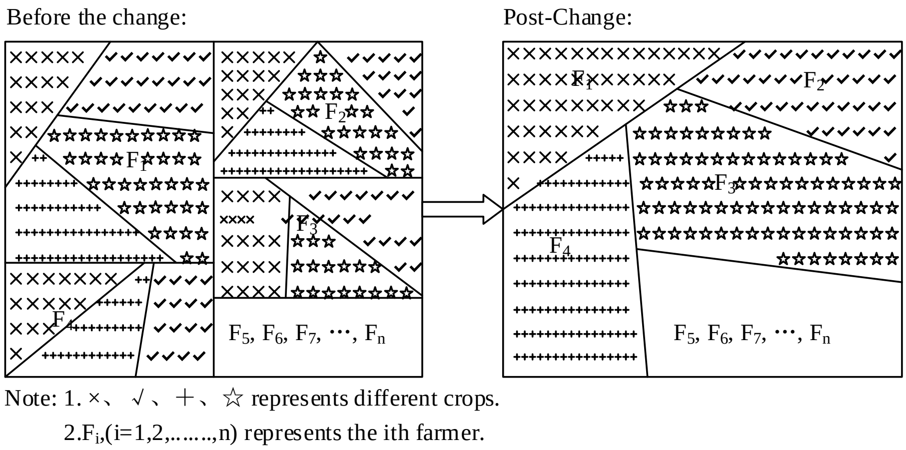

Figure 4. Change of farmers' production mode

If m consumer has a food basket Q_m with n product categories, the i th consumer's demand for the J th product is q_{ij}, $i=1,2,\cdots m$, and $j=1,2,\cdots n$, i.e., the total demand is:

$$Q=\left|Q_1 Q_2 \cdots Q_m\right|^T \tag{1}$$

The platform breaks down and integrates the original order based on the category of product demand, and integrates the new order for:

$$\begin{cases} Q_j=\left|q_{1j} \quad q_{2j} \quad \cdots \quad q_{nj}\right|^T \\ Q^N=\left|Q_1 \quad Q_2 \quad \cdots \quad Q_n\right| \end{cases} \tag{2}$$

The new media platform then selects appropriate agents for consumers and outsources new orders Q^N to eligible agricultural cooperatives. This way of processing information about the orders and sorting them into production allows for inventory-free centralized purchasing for decentralized consumers and scale customization for personalized needs, which is unsurpassed by traditional brick-and-mortar supermarkets.

2.3.3 "New media + agricultural cooperatives" decision-making model

1) Centralized decision-making model (H_1)

T and F_1, F_2... F_n are fully cooperative, i.e. the new media platform (hereinafter referred to as the platform) and the agricultural cooperative make decisions as a whole. There are two risk transfer paths: one is the risk from the consumer, the risk flow from the consumer directly to the platform. This path has the least number of risk flow links and the strongest ability to resist risk. The second is the risk from agricultural cooperatives, and the risk cost consists of two parts: the platform risk and the agricultural cooperative risk.

The value at risk of agricultural cooperatives and consumers are r_F and r_C respectively, the probability of risk occurrence of agricultural cooperatives and platforms are p_F and p_T respectively, the immunity to risk is α, and the coefficient of cost of risk is δ. In this decision state, the platform and agricultural cooperatives make a joint decision, and the cost of risk is the sum of the cost of risk of the platform, the cost of risk of the agricultural cooperatives, and the value at risk of the platform and the cost of risk occurrence are respectively:

$$r_T=\alpha\exp\left(r_C\right) \tag{3}$$

$$C_t^{H1}=C_t^{H1}=\delta p_T r_t \tag{4}$$

The value at risk and the cost of risk incurred by agricultural cooperatives are respectively:

$$r_F=\alpha\exp\left(-r_C\right) \tag{5}$$

$$C_f^{H1}=\delta p_F r_F \tag{6}$$

2) Fully decentralized decision-making model (H_2)

T and $F_1,\ldots,F_n$ act as 2 independent decision-making individuals in a Stankelberg game. n agricultural cooperatives compete freely at the same time, there is only one risk transfer path, the risk flow is from consumers through agricultural cooperatives to the platform, there are more risk flow links, the risk cost is larger, and there is no negotiation priority for centralized decision-making and fully decentralized decision-making models. The homogeneous agricultural cooperatives as an independent individual and the platform for the evolution of the game, the platform's value at risk, risk immunity and the probability of risk occurrence are r_T, α and p_T, respectively, the platform and the risk of agricultural cooperatives are:

$$r_T = \alpha \exp(-r_F) \tag{7}$$

$$r_F = \alpha \exp(-r_C) \tag{8}$$

The cost of risk for both is respectively:

$$C_t^{H2} = \delta p_T \left(1-(1-p_F)^n\right) r_T \tag{9}$$

$$C_f^{H2} = \delta p_F r_F \tag{10}$$

Where $1-(1-p_F)^n$ denotes the joint probability of risk occurrence in agricultural cooperatives.

3) Farmer model (H_3)

T and $F_1,\ldots,F_n$ play a Stankelberg game as $n+1$ independent decision making individuals.

F_1 decides their sales volume q_i based on $F_{i,i>1}$ sales volume. At this point, F_1 engages in an evolutionary game with the remaining farmers, where all small farmers compete simultaneously in a free-for-all to equally share the remaining sales and profits. The risks of the platform and the agricultural cooperative are $r_T = \alpha \exp(-r_F)$ and $r_F = \alpha \exp(-r_C)$, respectively, and the costs of risk for each are:

$$C_t^{H3} = \delta p_T p_F r_T \times \left(1-(1-p_F)^{n-1}\right) \tag{11}$$

$$C_f^{H3} = \delta p_F r_F \tag{12}$$

4) Decentralized cooperation model (H_4)

T and $F_1,\ldots,F_m$, F_M as $m+2$ independent decision-making individuals in a Stankelberg game. Let the marginal cost of F_M be C_M, the sales volume be q_M, the risk of the platform and the agricultural cooperative be $r_T = \alpha \exp(-r_F)$ and $r_F = \alpha \exp(-r_C)$, respectively, and the risk cost of the platform be:

$$C_t^{H4} = \delta p_T p_F^{n+1-m} \times \left(1-(1-p_F)^{m-1}\right) r_T \tag{13}$$

The cost of risk for Cooperative F_M (participating cooperative farmers) is:

$$C_M^{H4} = \delta p_F^{\ n-m} r_F \tag{14}$$

The cost of risk for smallholders (non-participating cooperative farmers) is

$$C_f^{H4} = \delta p_F r_F \tag{15}$$

5) Centralized cooperation model (H_5)

T and $F_2, \cdots, F_k$, F_K as $k+1$ independent decision-making individuals in a Stankelberg game. Let the marginal cost of F_K be C_K, the sales volume be q_K , the risk of the platform and the farmer be $r_T = \alpha \exp(-r_F)$ and $r_F = \alpha \exp(-r_C)$, respectively, and the risk cost of the platform be:

$$C_t^{HS} = \delta p_T p_F^{n+1-k} \left(1 - \left(1 - p_F\right)^{k-1}\right) r_T \tag{16}$$

The cost of risk for Cooperative F_K (participating cooperative farmers) is:

$$C_{fK}^{HS} = \delta p_F^{n-k+1} r_F \tag{17}$$

The cost of risk for smallholder farmers is:

$$C_f^{HS} = \delta p_F r_F \tag{18}$$

The agricultural cooperative and the new media platform play the game in the above five scenarios, and the optimal decisions are different in different scenarios. The income of the agricultural cooperative consists of the benefit distribution rate θ, market price P , sales volume $S(q,R)$, residual product value $rL(q,R)$, and the income from land transfer R , and the expenditure of the farmers is determined by the marginal cost C_F and the risk cost C_f^{HI} . Platform income consists of yield distribution rate θ, market price P , sales volume $S(q,R)$ and residual product value $rL(q,R)$. Platform expenditures are determined by land transfer proceeds R , marginal costs C_T and risk costs $C_t^{HI} : C_J^{HI} = C_J + C_J^{HI}$. Agricultural Cooperative Costs:

$$C_M^{H4} = C_M + C_{MA}^{H4} \tag{19}$$

$$C_K^{H5} = C_K + C_{fK}^{HS} \tag{20}$$

3 Analysis of marketing channel model options for agricultural cooperatives

3.1 Marketing Channel Model Data Collation

3.1.1 Data sources

The survey for this study comes from the Statistical Yearbook of Agricultural Cooperatives in China, 28,450 cooperatives engaged in the business of selling agricultural products, and the data used in this chapter is mainly for the study on the use of marketing channels for agricultural products in cooperatives. The study provides a total of 12 marketing channel models that cooperatives may utilize, including cooperatives docking with wholesalers (1), wholesale markets (2), processing enterprises (3), supermarkets (4), hotels or catering outlets (5), institutions (6), communities (7), franchise stores (8), third-party logistic enterprises (9), exporters (10), new media platforms (11), or other models (12) etc. The content covers the names of agricultural products of category 1 or 2 sold by the cooperative and the proportion of sales through each channel mode, the availability of channel modes, the means of contacting buyers in each channel, the determinants of the transaction price, the location of the transaction, the means of payment, defaults in the transaction, the fulfillment of the required order quantities, the frequency of transactions per year, the stability of the transaction relationship, and the means of securing the transaction, among other things.

The use of the marketing channel mode of 28450 agricultural cooperatives is shown in Table 1. It can be seen that among 28450 cooperatives engaged in the business of having agricultural products for sale, 2617 cooperatives are marketing through the new media platform channel, accounting for only 9.2%.

Table 1. The use of the sample distribution channel model (Omission)

ID	Marketing channel model											
	1	2	3	4	5	6	7	8	9	10	11	12
00001	—	—	—	√	√	—	—	—	—	—	—	—
00002	√	—	—	—	—	—	√	—	—	√	—	—
00003	—	—	—	√	√	—		—	—	—	—	—
00004	—	—	—	—	—	—	√	—	—	—	—	—
00005	—	√	√	√	√	—	√	—	—	—	—	—
00006	√	—	—		√	√	—	—	—	—	—	—
00007	—	—	—	√	√	—	—	√	—	—	√	—
00008	√	—	√		√	—	—	—	—	√	—	—
00009	—	√	—	√	—	—	—	—	—	—	—	—
00010	—	√	—	√	√	—	—	—	—	—	—	—
00011	√	√	—	√	—	—	—	—	√	—	—	—
00012	—	—	—	√	—	—	√	—	—	—	—	—
00013	—	—	√		—	—	—	—	—	—	—	—
00014	√	—	—	√	—	—	—	—	—	√	—	—
00015	—	—	—		—	—	—	√	—	—	—	—
00016	—	—	—		—	—	—	—	—	—	—	—
…	…	…	…	…	…	…	…	…	…	…	…	…
Total	8649	5804	5263	13002	12319	2134	341	1593	882	6287	2617	28
	0.304	0.204	0.185	0.457	0.433	0.075	0.012	0.056	0.031	0.221	0.092	0.001

3.1.2 Difficulty in selling the sample products

The results of the point density distribution of the difficulty of selling the products of the 28,450 Chinese agricultural cooperatives studied are shown in Figure 5. The difficulty of selling the products of agricultural cooperatives in this study is divided into five levels, i.e., “no difficulty, very good sales” sales difficulty distribution interval is [0,40], “less difficult” [40,60], “general “[60,80], “more difficult” [80,90] and very difficult [90,100]. Of these, 1,101 cooperatives were very difficult and 2,100 cooperatives were difficult to sell. There are 5,778 cooperatives with average selling difficulty, accounting for 20.31% of the total sample. There were 8,899 cooperatives with less difficulty in selling, accounting for 31.28% of the total. There were 10,572 sample cooperatives, or 37.16% of the total, which indicated that there were no problems at all in selling their products. It was also found that most of the 2,617 cooperatives that conducted marketing through the new media platform channel were distributed in the [0,40] range, indicating that none of the cooperatives that marketed through the new media had much difficulty in selling their products.

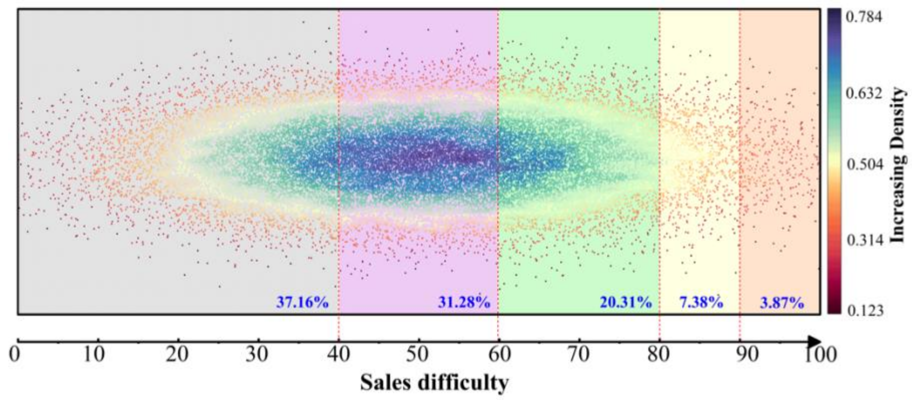

Figure 5. Point density distribution of difficulty in selling agricultural cooperative products

3.1.3 Price volatility of sample products

Figure 6 shows the volatility of product prices in the sample of 28,450 Chinese agricultural cooperatives. There are 1,536 sample cooperatives with basically no fluctuations in product prices, and 6,495 sample cooperatives with fluctuations of less than 10 percent, accounting for 22.83 percent of the total. There were 10,930 sample cooperatives with fluctuations of about 10 to 30%, accounting for 38.42% of the total. There are 7707 sample cooperatives with fluctuations around 30~50%, accounting for 27.09% of the total. And there are 1,781 sample cooperatives with fluctuations of more than 50%, accounting for 6.26% of the total. The fluctuation range of these cooperatives is high, but the fluctuation range of the prices of most of the products relying on agricultural cooperative sales is moderate. It was also found that the price fluctuations of the products of the 2,617 cooperatives that conducted marketing through the new media platform channel were all distributed between 0 and 10%, indicating that through the new media marketing channel, the prices of cooperative products can be stabilized.

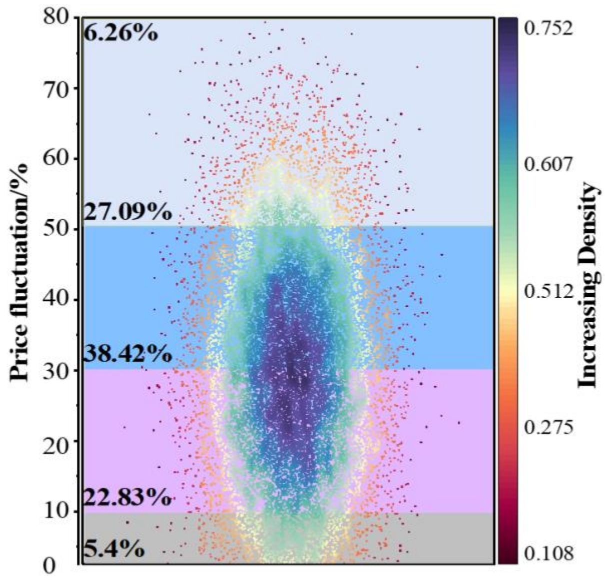

Figure 6. Fluctuations in the prices of agricultural cooperatives' products

3.2 Game Analysis of New Media Marketing Channels for Agricultural Cooperatives

3.2.1 Game assumptions

In the study, we simulate the process of the game by giving examples to derive the pricing strategies of dealers and the marketing channel selection behaviors of agricultural cooperatives in two different market structures to obtain the corresponding observations. The effectiveness of the game is analyzed by combining the centralized (H_1), fully decentralized (H_2), farmer (H_3), decentralized cooperative (H_4) and centralized cooperative (H_5) decision-making models proposed in the previous section on "New Media Platform + Agricultural Cooperative" marketing.

In order to simplify the process of game model derivation, this study assumes that, along with the previous assumptions about the quality level and production cost of agricultural products, as well as the roles of dealers and consumers,

1) The cost of production of a low-quality agricultural product is $C_1 = 0$, the cost of production of a medium-quality agricultural product is $C_2 = 1$, and the cost of production of a high-quality agricultural product is $C_3 = 2$.

2) 2) M_i is the consumer's reservation price for the agricultural product i, such that the consumer's reservation price for the low-quality agricultural product is $M_1 = 1$, the reservation price for the medium-quality agricultural product is $M_2 = 2$, and the reservation price for the high-quality agricultural product is $M_3 = 4$.

3) The new media platform earns a profit of at least δ for each product. It has been assumed that the consumer's reservation price for low-quality agricultural products is 1. The maximum selling price for low-quality agricultural products should be 1. In order to ensure that the new media platform has the possibility of marketing agricultural products of all quality levels, let $\delta < 1$.

3.2.2 Analysis of the stability of "new media + cooperatives" marketing channels

The centralized decision-making (H_1), fully decentralized decision-making (H_2), farmer (H_3), decentralized cooperation (H_4) and centralized cooperation (H_5) in the marketing of "new media platform + agricultural cooperatives" are analyzed in the evolution of the Stankelberg game. In this paper, the parameters constituting the equilibrium solution are assigned values as shown in Table 2, the specific values of the equilibrium solution are calculated, and the stability of the equilibrium point is analyzed according to the specific values.

Table 2. Parameter Settings

Parameter	Decision 1	Decision 2	Decision 3	Decision 4	Decision 5
Γ_1	0.1	0.1	0.1	0.1	0.1
Γ_2	0.2	0.2	0.2	0.2	0.2
Γ_3	0.4	0.4	0.4	0.4	0.4
Ψ	10	10	10	10	10
ε_1	0.1	0.1	0.2	0.3	0.2
ε_2	0.3	0.3	0.5	0.5	0.5
M	20	20	20	20	20
σ_1	0.1	0.1	0.2	0.1	0.1
σ_2	0.05	0.05	0.1	0.1	0.05
Σ	0.2	0.2	0.2	0.2	1

1) Substitute the values of the parameters in the centralized decision-making (H_1) proposed by marketing into the equilibrium point and Jacobi matrix, bring the equilibrium point into the Jacobi matrix with specific values, and judge the stability of the equilibrium point according to the positive and negative characteristic roots of the matrix. The characteristic roots of the equilibrium points are shown in Table 3, and according to the positive and negative results of the calculated characteristic roots, it can be seen that the characteristic roots of the local stability strategy (ESS) of "farmers + agricultural cooperatives + new media platform" under the centralized decision-making are (-4,-1,-1) and (-4,-4,-2), which are expressed as the strategies of (non-cooperation, non-cooperation, non-cooperation) and (cooperation, cooperation, non-cooperation) and (cooperation, cooperation, non-cooperation), respectively.) strategies as well as (cooperative, cooperative, cooperative) strategies.

Table 3. The characteristic roots and local stability of H_1

Equalization point	Characteristic root	Local stability
E1= (0,0,0)	(-4, -1, -1)	ESS
E2= (1,0,0)	(-4, -1, 1)	Saddle point
E3= (0,0,1)	(-1, -1, 4)	Saddle point
E4= (1,0,1)	(1, 4, 4)	Unstable point
E5= (0,1,0)	(-4, -10)	Saddle point
E6= (0,1,1)	(1, 24)	Unstable point
E7= (1,1,0)	(1, 1, 24)	Unstable point
E8= (1,1,1)	(-4, -4, -2)	ESS
E9	(1.151, -1.151, 0.58)	Saddle point
E10	(1.751, -1.751, 0.26)	Saddle point
E11	(-0.781, -0.781, 4.38)	Saddle point

2) On the basis of strategy 1, change the coefficient of income distribution of farmers and cooperatives to get the data of fully decentralized decision-making. The characteristic root of each equilibrium point of strategy 2 and the evolutionary stability of each equilibrium point are shown in Table 4. According to the calculated positive and negative results of the characteristic root, it can be seen that on the basis of strategy 1, change the coefficient of benefit distribution of farmers and cooperatives, that is, in the case of strategy 2, the local stability strategy of farmers + cooperatives + new media platform is (-4, -1, -1), that is, (non-cooperative, non-cooperative, non-cooperative).

Table 4. The characteristic roots and local stability of H_2

Equalization point	Characteristic root	Local stability
E1= (0,0,0)	(-4, -1, -1)	ESS
E2= (1,0,0)	(-4, -1, 1)	Saddle point
E3= (0,0,1)	(-1, -1, 4)	Saddle point
E4= (1,0,1)	(4, 1, 8)	Unstable point
E5= (0,1,0)	(-4, 1, 1)	Saddle point
E6= (0,1,1)	(-1,1, -1)	Saddle point
E7= (1,1,0)	(1, 1, -4)	Saddle point
E8= (1,1,1)	(-8, -8, 1)	Saddle point
E11	(-0.8341, -0.8341, -4.9423)	Saddle point

3) On the basis of strategy 1, changing the cost-sharing coefficients of farmers, cooperatives and new media platforms to obtain strategy 3, i.e., the values of the farm owner model, the characteristic roots of each equilibrium point and the evolutionary stability of each equilibrium point are shown in Table 5 below. It can be seen that on the basis of strategy 1, the locally stable strategy points of the farm owner model by changing only the farmers, cooperatives and new media platforms are (-5, -3, -1) and (-9, -3, -3), i.e., (non-cooperative, non-cooperative, non-cooperative) as well as (cooperative, cooperative, cooperative) strategies.

Table 5. The characteristic roots and local stability of H_3

Equalization point	Characteristic root	Local stability
E1= (0,0,0)	(-5, -3, -1)	ESS
E2= (1,0,0)	(-5, -1, 3)	Saddle point
E3= (0,0,1)	(-5, -3, 1)	Saddle point
E4= (1,0,1)	(1, 3, 5)	Unstable point
E5= (0,1,0)	(-3, -1, 5)	Saddle point
E6= (0,1,1)	(1, 2, 5)	Unstable point
E7= (1,1,0)	(3, 5, 9)	Unstable point
E8= (1,1,1)	(-9, -3, -3)	ESS
E9	(1.0957, -1.0957, 1.7351)	Saddle point
E10	(0.9812, -0.9812, 0)	Saddle point
E11	(1.5441, -1.5441, -0.4023)	Saddle point

4) On the basis of strategy 1, change the benefit distribution coefficients of farmers, cooperatives and new media platforms, as well as the cost-sharing coefficients of cooperatives and new media platforms, to obtain the decentralized cooperation (H_4) model, which has the characteristic roots of each equilibrium and the evolutionary stability of each equilibrium as shown in Table 6. In this model, the local stabilization strategies of farmers + cooperatives + new media platforms remain (no cooperation, no cooperation, no cooperation) as well as (cooperation, cooperation, cooperation).

Table 6. The characteristic roots and local stability of H_4

Equalization point	Characteristic root	Local stability
E1= (0,0,0)	(-8, -4, -1)	ESS
E2= (1,0,0)	(-8, -1, 4)	Saddle point
E3= (0,0,1)	(-4, -1, 8)	Saddle point
E4= (1,0,1)	(1, 4, 8)	Unstable point
E5= (0,1,0)	(-8, -4, 1)	Saddle point
E6= (0,1,1)	(1, 4, 4)	Unstable point
E7= (1,1,0)	(1, 8, 8)	Unstable point
E8= (1,1,1)	(-8, -4, -4)	ESS
E9	(1.2390, -1.2390, 1.6657)	Saddle point
E10	(1.6337, -1.6337, 0)	Saddle point
E11	(1.0531, -1.0531, 3.8500)	Saddle point

5) On the basis of strategy 1, only changing the amount of liquidated damages to obtain the centralized cooperation (H_5) model, the characteristic roots of each equilibrium point of this model and the evolutionary stability of each equilibrium point are shown in Table 7. Without changing the benefit distribution coefficient of farmers, cooperatives and new media platforms, or the cost-sharing coefficient of farmers, cooperatives and platforms, and only changing the number of liquidated damages, the local stabilization strategy of farmers+cooperatives+new media platforms is (cooperation, cooperation, cooperation). At this time, because the default payment amount is too high, all three parties involved choose the cooperative strategy to avoid losses.

Table 7. The characteristic roots and local stability of H_7

Equalization point	Characteristic root	Local stability
E1= (0,0,0)	(-1, 0, 0)	Saddle point
E2= (1,0,0)	(-1, -1, 0)	Saddle point
E3= (0,0,1)	(0, 0, 1)	Unstable point
E4= (1,0,1)	(0, 1, 2)	Unstable point
E5= (0,1,0)	(-2, 0, 0)	Saddle point
E6= (0,1,1)	(0, 2, 2)	Unstable point
E7= (1,1,0)	(0, 1, 2)	Unstable point
E8= (1,1,1)	(0, 0, 2)	ESS
E9	(0, 0, 0)	Saddle point
E10	(0, 0, 0)	Saddle point
E11	(0, 0, 2)	Saddle point

Combining the above results, this paper uses the software to derive the characteristic root and judge the evolved stable strategy according to the positive and negative of the characteristic root so as to carry out the stable strategy analysis. Through the evolutionary game analysis, it shows that agricultural cooperatives and new media platforms choose cooperation strategy or non-cooperation strategy, which is related to the coefficient of benefit analysis, coefficient of cooperation cost, and liquidated damages of both parties' cooperation.

4 Conclusion

Based on cooperative theory, transaction cost theory, marketing channel theory and game theory, this study takes the agricultural marketing activities of 28,450 agricultural cooperatives in China as the data source and adopts a combination of quantitative and qualitative analytical methods to explore the operation mechanism, decision-making mode, and influencing factors of the marketing channel model of "new media + agricultural cooperatives". The operation mechanism, decision-making mode and influencing factors of the marketing channel model of "new media + agricultural cooperatives" are discussed. Finally, in order to successfully implement the dynamic marketing of "New Media + Agricultural Cooperatives", the stability analysis shows that it is necessary to put forward safeguard measures from the aspects of revenue, cooperation cost and liquidated damages, and the specific recommendations are as follows:

1) In terms of revenue and cooperative costs, establish a revenue-sharing and cost-sharing mechanism. Establishing a reasonable benefit-sharing and cost-sharing mechanism can enhance the level of cooperation between the new media platform and the docking body of agricultural cooperatives. The mechanism of benefit sharing includes two types of contractual benefit sharing, which are based on market price, market demand, and production cost.

2) Establish and improve the punishment and constraint mechanism. The amount of liquidated damages can affect the choice of stabilization strategies for the participating members of the new media platform and agricultural cooperative docking. In the process of cooperating between new media platforms and agricultural cooperatives, it is necessary to establish a sound punishment and constraint mechanism. Establish a reasonable transaction margin to prevent members from engaging in opportunistic behavior and reduce the default phenomenon. Ensure effective supervision of cooperation between subjects by introducing a third-party agency or through the local market supervision department.

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