Game Model of E-commerce Information Sharing in Agricultural Product Supply Chain

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ABSTRACT: The supply chain of agricultural products in China has developed steadily in the past decades. However, with the development and application of information technology, some traditional supply chain business models have been replaced by e-commerce. Under the environment of e-commerce, a new model of supply chain information sharing of agricultural products can be constructed to realize the effectiveness of supply chain information of agricultural products. Taking the agricultural products of Xinjiang as an example, the existing problems of information sharing in the supply chain of agricultural products in Xinjiang at the present stage were analyzed by consulting the relevant theories of supply chain information sharing and information game in this study. Moreover, a new model of information sharing game based on e-commerce supply chain was proposed. The results showed that the model has good market adaptability. Compared with the traditional supply chain game process, the new model can reduce inventory, improve the efficiency of inventory release, thus improving the efficiency of information sharing in the supply chain.

INTRODUCTION

Economic development is the process of globalization at this stage. The intensity of competition in the market economy has extended to the traditional agricultural products market. In the course of market competition with other commodities, agriculture products have been at a disadvantage. Therefore, faced with such challenges, the marketization process of agricultural products is facing a severe dilemma [1]. However, challenges and opportunities sometimes exist simultaneously. Our country is vast in territory and is a big agricultural country. China has a unique resource base of natural environment. Our country also has a lot of material guarantee so as to develop some characteristic agriculture. But at the same time, the problems existing in our country's agricultural product supply chain have been long-standing. The main problems are that the structure of the supply chain is unscientific and the range of application and popularization of information technology is narrow, and a lot of information about logistics and products is asymmetric.

Logistics information and system are not perfect, and the process of production and sale of agricultural products are too long and there is no uniform standard in the process of circulation [2]. Under such circumstances, the supply side of agricultural products has the randomness and dispersion of the market, which is not conducive to reducing the processing cost of agricultural products. In the future, we need to develop a new mode of circulation of modern information technology, and set up green industrial chains with many levels and perfect structure, which will play a more important role in the development of agricultural products [3]. How to complete the circulation of information from the land to the table and facilitate the timely sharing of the information of agricultural products are the continued problems of the development of China's agricultural products at this stage.

The process of production and sale of agricultural products usually has the problem of asymmetric information. This led to the fact that many agricultural products are of high quality but are unsalable. And some areas do not know where to buy such agricultural products [4]. In this way, the lag of information will lead to both sides of the supply side unable to meet their own needs, affecting the long-term development of agricultural products. Through reading a large number of documents, the theory of information sharing and information
sharing game theory were studied in this study. In view of the low efficiency of the agricultural product supply chain operation process in China at the present stage, a game model of electronic commerce information sharing suitable for characteristic agricultural products was explored by analyzing the control process of supply chain and the key information technology [5]. Taking Xinjiang as an example, the e-commerce supply chain information sharing model of characteristic agricultural products could enhance the standardization and standardized management of the industry, and enhance the core competitiveness of specialty agricultural products, which also helps to upgrade the production and trading of agricultural products. Furthermore, it can solve the problems of asymmetric information and nonstandard information of agricultural products, and effectively solve the problem of inefficient operation of the supply chain of agricultural products [6]. Through the relevant results of this study, the driving role can not only promote the transfer and coordination of agricultural products information, but also realize the management of artificial intelligence in the mechanism of agricultural products information supply. Technology management and the whole monitoring system can improve the advantages, and hope that it has the international competitiveness in the future.

2. Supply chain and e-commerce information sharing theories

2.1 Overview of relevant theories of information sharing in supply chain

The concept of supply chain is put forward on the basis of the theory of value. The initial concept understanding is mainly about the standardized operation process of the enterprise so as to promote the enterprise's own resources to control and plan the target [7]. Later, after a series of development, scholars link supply chain with purchasing and enterprise management, and extend this concept to the transactions between enterprises and enterprises. With the development and maturity of economic globalization, enterprise management has risen to a new level. The basic concept of supply chain has also been improved. Our country has already realized the importance of the supply chain, and the same cognition that the supply chain can meet the enterprise information convection and material support information [8]. Each link forms a network connection of the whole function from the beginning of procurement through intermediaries processing, and finally transferred to consumers to conduct the process summary [9]. Supply chain is not only a business management chain, but also a set of value-added management chain. The concept of supply chain of agricultural products refers to the control and management of goods and cash flow around agricultural values in the process from agricultural products purchasing to the final distribution to consumers in a particular line of product supply [10]. A supply network between farmers, processing, middlemen, and retailers is formed. Fig. 1 shows a flow chart of the supply chain of agricultural products.

![Flow chart of agricultural product supply chain](image)

The most basic purpose of supply chain management is to solve communication barriers between enterprises. The information isolation structure of each enterprise is effectively linked through the supply chain. In the internal and external of the enterprise, a set of demand management is formed to better coordinate the interests of the enterprise in the supply chain management [11]. Supply chain managements involve more advanced methods of enterprises to meet supply, production, planning logistics and enterprise needs. The ultimate goals are to reduce the operational costs of enterprises and seek to improve the service level while reducing the cost of the game process. This provides long-lasting help for production planning [12]. The supply chain management of agricultural products is a management method applied in the agricultural field. It tries to realize the organic whole management in the process of production, processing, storage and sale of agricultural products. For this process, relevant agricultural information is coordinated and communicated in order to obtain value-added processes of agricultural products [13]. The effective combination of the supply chain
management of agricultural products and the application model of e-commerce are new type of business model innovations, and also produces a research upsurge in this field. Customers can use a full business supply chain to reduce operating costs and enhance control degree of the enterprise to market and customer, and it will be more leisurely responding to market changes [14]. Purchasing of agricultural products raw materials, processing of agricultural products, and distribution mix of agricultural products after processing can enhance the overall market competitiveness of enterprises. Fig. 2 shows schematic diagram of supply chain management.

![Fig. 2 Sketch map of supply chain management](image)

2.2 Overview of information sharing game theory in supply chain

Due to the hierarchical structure restriction of the supply chain, compared to the traditional supply chain, the structure of the supply chain will carry out its own demand forecast for the downstream structure. Therefore, it may be common for possible asymmetric information when arranging about production plans [15]. Therefore, the more information processed, the greater the degree of distortion of information. The storage and transportation of the products are cost effective, and these costs control the formation of the final profit. Inventory can only be purchased when inventory reaches a certain level [16]. The volatility of the market will affect the supply characteristics of downstream suppliers, so randomness is also possible. The bullwhip effect produces in the period of concentrated randomness. Fig.3 shows a schematic diagram of the bullwhip effect. It can be seen from Fig.3 that the general supply chain management process is that the market shifts demand from retailers to production to suppliers. Fluctuations can lead to inventory backlogs. The level of service will also decline accordingly, which will directly lead to an increase in operating costs [17]. Bullwhip effect is the expression and description of enterprise supply node information distorted or extended downstream the problem of low efficiency of information. The bullwhip effect will continue to enlarge the supply chain inventory quantity and the cost will be straight up [18]. Despite the backlog of stock, however, there will be no coordination between supply and demand. In some cases, shortages of some products reduce corporate profits. Wrong prediction of the market will lead to production and schedule and market demand seriously inconsistent, and ultimately affect the survival and development of enterprises.

![Fig. 3 Schematic diagram of the bullwhip effect](image)

Information game is divided on the basis of information economics, and it requires the research in two different levels. In view of the order of participation structure, the characteristic strategic situation is understood. The game of general information will also appear dynamic game and static game, and it can also be divided into incomplete game and complete game. To achieve complete competition and game state is more idealistic. The dynamic game process needs the order of information circulation, and the sequential game behavior can be seen [19]. In the static game, it is simultaneous. Actions have priority, and decision information is fair. Static game can achieve more fair information transparency. Usually, the evaluations of the best interests of the circulation of the enterprise in the supply chain include the centralized control of inventory and the construction of the information base of quantity buyback. There are also some supply chains that focus on maximizing the benefits of the business. Profits are the ultimate goal of rationalization, and the supply chain can be assumed to be completely controllable. In the today with rich information, the enterprise must obtain the decision-making information ability and the competitive power [20]. The internal and external modes of information require enterprises to reach the maximum information flow of the supply chain from the whole strategic decision. This requires enterprises to complete information integral link information flow that manages themselves and the
market, and maximum solve asymmetry of logistics, capital flow and information flow.

3. Research on the new model of e-commerce information sharing game based on the supply chain of agricultural products

3.1 Analysis of information sharing model of e-commerce supply chain of agricultural products

The point to point information sharing model refers to establish its own information system in each link of the supply chain. The model stores all the application information directly into the database. This supply control model is characterized by the direct transfer of information to demand enterprises, and can deliver to the demand side without data transfer. Through multiple information systems or databases transfer, information accession will experience a lot of correspondence. Therefore, the specific implementation process is divided into different patterns. One of them is the commonly used EDI model. The model enables links between business partners based on the characteristics of the data lines and the value added of the network. However, the cost of this model is relatively high, and the number of EDI will be several times as many as that of the shared enterprise in the information sharing phase. Therefore, cost has been the biggest obstacle to the extension of the model. The model can’t conduct centralized collection and maintenance of information. Through the value-added network, the functions of the model can be achieved. Simple point to point delivery of information is still more applicable, which is shown in Fig.4.

Generally, the exchange of information between organizations can lead to some contradictory data. The difference between information processing and organization often leads to the distortion of information transmission. Mature and accurate information flows need to ensure accurate attributes and uniform format. However, the transfer of information from point to point can cause inconsistent attributes and inconsistent information. In this way, the accumulated information will lead to all links in the supply chain coordinate the sharing of information will be distort. A form of third parties should be adopted to avoid similar problems. The third party organizations can concentrate their efforts on data flow collection. After processing, it gives additional information to supply chain management. Therefore, the process of information processing is successfully involved. Termination of the contract may result in disruption or disclosure of past collaboration data. Therefore, the model is needed to ensure that firms with high credit ratings do the job. Fig.5 shows a third party information processing model.

The information platform sharing model is proposed to replace the third party companies, and form the process of information flow in the enterprise. According to the database and transmission processing of computer intelligent, it can be calculated. The information sharing model needs to form its own operation module for different characteristics of the enterprise. The nodes of the supply chain agree with themselves, and security and fairness can be guaranteed. Enterprises on the supply chain platform communicate instructions remotely over the network according to their own needs. There are data that can be queried in all jobs. Reliability and accuracy are guaranteed. This model can communicate with each other through the information platform for the data sharing model in different regions. Fig.6 shows the information platform sharing model.
3.2 Game analysis of new and old model of agricultural product e-commerce supply chain information sharing

Taking Xinjiang agricultural products as the case study, a basic analysis of the information sharing and supply chain development of agricultural products in this region was made in this paper. The questionnaire was used as the research method. More than 40 companies were investigated, and relatively large impact of agricultural products processing and marketing companies were selected. The development status of regional agricultural information supply chain was analyzed through the method of point difference questionnaire and recycling in this paper. 12 questionnaires were sent out by sending e-mail and 10 questionnaires were recovered. The main research questions included the actual application of the existing information sharing technology, and the trust status among organizations in the process of sharing information.

The information sharing mechanism of agricultural product supply chain is also a multi-stage inventory maintenance system. Each supply chain node and link management affects the multi-stage inventory nodes. Therefore, product decisions should be based on the authenticity of the data. Each node needs the result of performance evaluation to constrain the next step. This model can achieve overall coordination through information sharing, and reduce the system's high inventory accumulation. The model in this study can roll out inventory cycle processing quantities through retail information data and arrange order production. Compared with inventory, the new model of information sharing game based on supply chain can improve the management efficiency more effectively than the traditional model. Figure 7 shows the schematic diagram of the two-phase supply chain.

The traditional sales process calls for the sale of agricultural products to consumers, and retail prices fluctuate according to cyclical orders and quantity of purchases. Supply process is blind with batch production oriented. Figure 8 shows the traditional supply chain.

According to the above content, a supply chain management model of information sharing based on computer network can be proposed to solve the problem of information blocking. Figure 9 shows the supply chain diagram of the inventory sharing information system. No matter what the prices of the agricultural products in the market, the enterprises under the model can clearly understand the proportion of sales and inventory, and then decide their own production arrangements. They do not fluctuate at random according to market prices.
form information regulation without information sharing. They can only pricing and design costs blindly. The total cost of the supply chain is calculated as follows.

\[ SC(Q) = \frac{D(A + S)}{Q} + \frac{Q(Hr + \frac{DHm}{P})}{2} \]  

The calculation mode of supply chain operations for processors is:

\[ SCM = D(A + S) \sqrt{\frac{Hm}{2PS}} + \frac{1}{2} \sqrt{\frac{2PS}{Hm}} \left( Hr + \frac{D}{PHm} \right) \]

The supply chain operating costs of the downstream retailers are calculated as follows.

\[ SCR = D(A + S) \sqrt{\frac{Hr}{2DA}} + \frac{1}{2} \sqrt{\frac{2DA}{Hr}} \left( Hr + \frac{DHm}{P} \right) \]

In the e-commerce environment, the supply chain information sharing model of inventory information needs to be combined with sales and supply. The goal is to make economic consumption less productive. The cost operating formula of the supply is as follows.

\[ SCT = \sqrt{2D(Hr + \frac{DHm}{P})(A + S)} \]

4. Comparison and analysis of new game model of supply chain e-commerce information sharing and traditional model

4.1 Research and analysis results and model proposed

The supply chain management of agricultural products based on e-commerce is a new management concept, and every link in the supply chain needs to share the operational risk. The essential function is to provide decision-making in order to optimize the agricultural production, inventory and sales in supply chain. Therefore, the basic work is to realize the enterprise information sharing in the supply chain. In order to study the enterprises of agricultural products, the importance of managing shared information in the supply chain was investigated. It can be seen through the questionnaire analysis that 80% of the enterprises believe that the supply chain information sharing is important, and 20% of enterprises believe that information sharing is unimportant. This shows that most of the enterprises still approve the supply chain information sharing model, and think the information sharing is very important, which is shown in Fig.10.

E-commerce information sharing based on supply chain can provide the demand information of agricultural products and the resource information of agricultural products when enterprises make decisions. The effective combination of the two can make reasonable business decisions. The demands are divided into the present market demand level and the future demand information. Resource information comes not only from the inside of the enterprise, but also from the suppliers and distributors of agricultural products. Therefore, it can be seen according to the results of the survey that 30% of the enterprises share the order information with the agricultural products, and 70% of enterprises keep their own information closed and do not communicate with other enterprises. 20% of the enterprises were willing to share their future planning needs with their partners and 80% of enterprises will not share their future agricultural products with other suppliers. Specific data are shown in Fig.11. It can be seen from Fig.11 that many agricultural enterprises in the supply chain of e-commerce information sharing are not in place, and most companies do not share information about future requirements.
A new game model was put forward for the supply chain of characteristic agricultural products and e-commerce information sharing in this study. In view of the complete structure of the logistics chain, the information chain and the capital chain of suppliers to consumers, it is hoped that agricultural products have value-added after processing, packaging and transportation. The operation of e-commerce can realize the information sharing of the whole agricultural product supply chain. Maximum services can be provided with a small cost, so that the entire supply chain efficiency of agricultural products can be greatly reduced, and stability can also be increased greatly. Through the use of computer information technology, farmers, suppliers and retailers can use terminals to link, which is helpful to realize the real-time tracking in the supply chain of agricultural products. It is also common to manage resources and share information throughout the process. The model is proposed based on that the internet technology achieves online information inquiries among production supply, supervision departments and logistics companies.

A new game model of information sharing game based on the e-commerce of agricultural product supply chain is shown in Fig. 12. The model sets up information sharing database by collecting information. Farmers can establish the basic attributes (inventory, origin and price) information base by organizing the department. The processing enterprises of agricultural products can carry out shipments and establish information databases according to the standards of agricultural products. Information is implemented through data structure patterns. Through the Internet technology, farmers and processing enterprises can achieve online contact. Through the information sharing platform, the supply chain can share the information. Processing enterprises and farmers access internal data through firewalls. This enables the Web service system to realize the service function, and can enable the enterprise to grasp the agricultural product supply, production and sale new game pattern.

Fig. 12 New model of information sharing game based on e-commerce of agricultural product supply chain

The new model of information sharing game based on E-commerce supply chain can reduce the cost of inventory. Compared with the traditional supply model, the information supply chain can reduce inventory and improve the efficiency of the supply chain inventory. The corresponding supply chain efficiency is also improved naturally.

4.2 Discussion

Because farmers themselves can’t complete the entire supply chain information database construction process, and only through government organizations can achieve the construction of information base. If e-commerce technology developments in some areas lack of capital reserves, the data interface model in the supply chain e-commerce information sharing game model can be used. Because the data transfer structure pattern is lower than the EDI model. In addition, the use of the system is relatively simple and easy to learn. Using a unified browser to access the Internet can make the system more compatible. The information transfer between the farmers and the processing enterprises adopts the shared data interface model. With the model of e-commerce replacing the traditional transaction mode, the optimized and upgraded version of EDI mode can be used to share information. Each supply chain node if information needs to share with each other. This can ensure the entire chain of agricultural products price setting, market information forecasting process accurate and stable. Information sharing game model based on e-commerce supply chain can combine the whole supply chain from the purchase of agricultural products to sales. After the supply chain information sharing, seamless convergence is achieved and the market is more accurate. The supply chain can be arranged according to the actual situation. Consumers can also query the origin of agricultural products through a complete information sharing platform to ensure the legitimate rights and interests of consumers. The production and processing enterprises of agricultural products can also share the data information according to the market demand of the sale terminal and stabilize the production, thus reducing the blindness of farmers’ planting. The game model of sharing information of supply chain after the e-business model can realize the transaction on the internet platform. In addition to achieve the convenience of the transaction, it can also guarantee the traceability of the whole transaction.
5. Conclusions

The development of the supply chain of agricultural products has entered a stable and mature stage. However, due to the instability of its own information transmission, the information on both sides of the supply and demand is asymmetric. In addition to unsalable products, there are some difficulties in the purchase of agricultural products. Based on consulting supply chain management, e-commerce applications and supply chain information sharing game theories, a game model of agricultural product information sharing which adapts e-commerce transaction model was proposed by drawing lessons from advanced agricultural products management concepts and information sharing models at home and abroad in this study. Taking the characteristic agricultural products in Xinjiang as a case, the method of investigation and analysis was adopted to discuss the present situation of information sharing of agricultural products supply chain in this region, and the necessity and feasibility to put forward the game model were obtained. The game model of electronic commerce supply chain information sharing can realize the transparency of supply chain recommendation information and the harmony of node communication between enterprises, and realize the flexible management of the whole process; so that the management cost and risk of supply chain can be controlled effectively, agricultural production has more planning and stability, and farmers can earn more income with less market risk. Agricultural products can achieve transparent and visual control from farm roads to dining tables, and the quality of agricultural products can be guaranteed. Since the game model proposed in this study is based on characteristic agricultural products, which has not been extended to most agricultural products in the future. Therefore, specific issues need to be discussed in detail, which may lead to model discomfort.

7. REFERENCES