



Research on Toughness Measurement and Improvement Countermeasures of Agricultural Product Supply Chain

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Abstract. Food is the most important thing for people. As a necessity of human daily life, the stability of its supply chain and product quality and safety have always been the focus of the whole society. Establishing a tough agricultural supply chain that can resist all kinds of shocks will be the inevitable requirement of China's modern circulation system and agricultural modernization. Starting from the current problems faced by China's agricultural product supply chain, this paper analyzes the necessity and urgency of establishing a toughness agricultural product supply chain, and then puts forward the measurement and Improvement Countermeasures of the resilience of agricultural product supply chain, to provide decision support for the realization of agricultural modernization under the new development pattern.

Keywords: Agricultural products · Supply chain resilience · Agricultural modernization

1 Introduction

The production and development process of agricultural products is different from that of the service industry or industry, because the production of agricultural products itself is vulnerable to periodic, seasonal, timely, regional, perishable and other natural causes, and the control and influence of various environmental resistance factors. In the modern supply chain, the supply of agricultural products is vulnerable to major emergencies such as natural disasters and public health events. However, such effects are random and have no rules to follow. In recent years, emergencies have occurred frequently, which has had a far-reaching impact on the development of agriculture, rural areas and even the whole economy and society, resulting in price fluctuations, imbalance between supply and demand, confusion of market order, and even unsalable problems of agricultural products. Agricultural products supply chain is a circular chain, in which capital flow, information flow, logistics and business flow are the main blood of the whole agricultural products logistics supply chain, supporting the whole supply chain. Supply chain security risks are mainly reflected in trade, transportation, information and capital liquidity. To improve the resilience of the supply chain, we must effectively solve the problems and challenges existing in the agricultural supply chain system.

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2 Problems Exist China's Current Agricultural Product Supply Chain

2.1 The Disadvantages of Traditional Circulation Gradually Appear

At present, China's traditional circulation channels of agricultural products mainly focus on the wholesale market of agricultural products. In this way, the network operation mode not only improves the operation efficiency, but also has the problems of multiple levels, multiple links, long time and strong dispersion [10]. With the rapid development of big data technology and the increasing market demand, the traditional circulation channel with agricultural products wholesale market as the core has gradually highlighted problems. In particular, due to the lag in the transmission of agricultural product information and the problem of asymmetric information in the upstream and downstream of the supply chain, which runs through the whole process from the entry of agricultural products into the market to the sale of products, unfair competition such as step-by-step price increase and false quotation appears. The information asymmetry between merchants and consumers not only leads to low transaction prices for producers and high transaction prices for consumers, but also leads to the lack of guarantee of product safety, which not only damages the interests of small farmers and wholesalers, but also fails to meet the needs of consumers. This decentralized circulation mode of agricultural products makes it difficult to integrate channels, which seriously restricts the further improvement of the circulation efficiency of agricultural products [5].

2.2 The Cold Chain Logistics System is not Perfect

Fresh agricultural products are perishable, perishable and difficult to preserve. To ensure the quality of products, low-temperature storage is required in every link of production, transportation, storage, transportation and distribution. At the same time, farmers must quickly transport agricultural products to the trading market after harvesting agricultural products, otherwise agricultural products are very prone to decay and deterioration. Therefore, in the process of commodity transportation after harvest, try to use cold chain logistics transportation, and try to ensure the quality of agricultural products. At present, China's cold chain transportation system is not perfect, with high circulation costs and serious losses. The logistics market lacks third-party logistics enterprises that meet the needs of cold chain transportation, especially the third-party logistics enterprises with cold chain transportation capacity and can cooperate with rural agricultural transportation enterprises. Although there are logistics enterprises with cold chain transportation capacity in some rural areas, they have the characteristics of backward transportation capacity, service level and cold chain network coverage. It is very easy to cause additional losses in the transportation of agricultural products, and the cold chain transportation of agricultural products still needs to strengthen scientific and technological innovation.

2.3 Lack of Information Construction

In the whole agricultural supply chain, a relatively stable, efficient and fast information network platform has not been built, and farmers have not been able to grasp the latest

market demand information and adjust and update agricultural production activities in time. The supply chain as a whole is not supported by an integrated information system platform, which is mainly reflected in the lack of data sharing in all links within the supply chain, resulting in a relatively low level of modern management of the supply chain as a whole. It also lacks effective safety control and supervision, resulting in the lack of systematization and integration [2]. On the one hand, the coverage of agricultural information networks is relatively scarce and agricultural information resources are limited. The construction of agricultural informatization is mainly concentrated in the eastern coastal areas of China, while the construction level of the central and western regions is low. On the other hand, the resources available for agricultural networks are very limited, and the lack of effective integration of supply and demand information often leads to unsalable agricultural products or it is difficult for consumers to buy the agricultural products they need. To sum up, the imperfect agricultural information system seriously restricts the development of agricultural product logistics and the rational allocation and utilization of resources.

2.4 Lack of Agricultural Products Logistics Talents

Talent is an important foundation for social development. At present, China still lacks the technical talents needed to establish the logistics system for agricultural products. For a long time, insufficient attention has been paid to the cultivation and retention of rural talents, farmers' cultural level is generally low, and most farmers lack relevant basic logistics knowledge and basic skills, which seriously restricts the effective establishment and operation of agricultural product logistics system [1]. In addition, the logistics of agricultural products have a wide variety and a large number, and the requirements for the processing, packaging, storage and transportation of agricultural products are more than other products. In recent years, although the logistics industry has developed rapidly and flourished, there are relatively few agricultural logistics professionals, and many professionals lack practical knowledge and ability. At the same time, college students have less desire for rural development, and the level of rural economic development is limited, and they do not pay enough attention to the level of rural economic development, which seriously hinders the development of agricultural product logistics in China.

2.5 The Government's Macro-control System is not Perfect

At present, China's agricultural production is relatively scattered, the degree of centralized production of agricultural products is low, and the quantity and scale are small, which is not conducive to the development of the regulatory system. In the fields of production and sales of agricultural products, on the one hand, it is difficult for consumers to master the information about agricultural products and the production, processing and circulation of agricultural products that suppliers need to understand and control in all links. On the other hand, consumers can not identify the safety indicators of agricultural products. Due to the current commodity market mechanism, it is difficult to reasonably identify and eliminate products that may have quality and safety risks, which leads to the failure of agricultural product market caused by information asymmetry. Therefore,

to solve the above problems, as a local government that controls a large number of information resources beyond the main body of commodity market trade, it should adopt certain mechanism arrangements to strengthen the supervision of the quality and safety of agricultural products.

3 The Urgency of Building a Toughness Supply Chain Of Agricultural Products

3.1 Enhancing the Resilience of Agricultural Supply Chain is an Urgent Requirement to Improve People's Livelihood and Rural Revitalization

The 14th five-year plan puts forward the development goals of "taking the road of Socialist Rural Revitalization with Chinese characteristics" and "improving agricultural quality, efficiency and competitiveness." We will implement the strategy of Rural Revitalization and development, further strengthen the new development pattern of taking cities and towns, supplementing agriculture with industry, promoting mutual promotion, harmonious development and common prosperity between workers and farmers in urban and rural areas, and actively promote the modernization of agriculture and rural areas. Enhancing the resilience of the supply chain of agricultural products is of great strategic significance to improve the effectiveness of the government's "three rural" work, promote the development of agricultural economy, improve farmers' income, and win the battle to get rid of poverty and become rich in rural areas [6]. The price and supply of agricultural products have always been the most important livelihood issue in China. The price fluctuation of agricultural products supply chain has not only seriously affected China's agricultural development level and income, but also caused the general rise of agricultural products prices and the rise of residents' consumption expenditure due to the asymmetric supply and demand of agricultural products market, which has led to the increase of China's consumer price index. In recent years, due to the impact of the COVID-19 epidemic, the traditional agricultural product market in some regions of China has experienced a serious phenomenon of unsalable agricultural products. At the same time, the agricultural product market in urban areas has also experienced problems such as soaring vegetable prices and lack of supply of vegetables. The above unforeseen external events reflect the main problems existing in the current food supply, and also illustrate the importance of improving the supply chain of agricultural products and strengthening the toughness of the supply chain of agricultural products to control the phased overcapacity of agricultural products, maintain the coordination between supply and demand of agricultural products and optimize the allocation of resources of agricultural products.

3.2 Improving the Resilience of Agricultural Products Supply Chain is the Need to Build a New Development Pattern

The central economic work conference pointed out that to establish a new development pattern, we need to lay a good foundation for the industrial chain and supply chain and solve some "neck" problems as soon as possible. In recent years, due to the deep impact

of animal epidemics and public health events on China's society and global economic operation, has highlighted the great significance of ensuring the safety and stability of China's industrial supply chain. Only by adhering to the independence and self-improvement of science and technology and breaking through the "neck" problem of core technology can we maintain the security and stability of China's industrial supply chain. We should firmly grasp the initiative of economic development, remove major obstacles, balance subtle links, and link output, distribution, circulation, consumption and other links together, to achieve a higher-level dynamic balance of supply and demand, in which demand leads supply and supply creates demand. Strive to improve the overall efficiency of the national economic structure and promote the establishment of a new pattern of economic development globalization guided by the foreign cycle and mutually promoted by the domestic and foreign double cycles. The same is true of modern agriculture. The problem of neck sticking should be solved in terms of quality standards, intelligent agriculture and agricultural transportation. In the environment of agricultural products supply chain, any cut link may form a chain reaction to the whole supply chain and cause economic losses to the industry and even the country [11]. One of the main goals of modern enterprises is to enhance the toughness of agricultural product supply chain, maintain the security and stability of the supply chain and realize the effective and coordinated development of upstream and downstream enterprises. At the same time, it ensures the smooth and effective operation of the global supply chain ecosystem, which is also the main goal of a country to develop economic and trade diplomacy and build an open global economic system.

3.3 Improving the Resilience of Agricultural Product Supply Chain is of Strategic Significance for the Development of Agricultural Industrialization

Agricultural industrialization is a major reform of China's agricultural management system and a necessary condition for agricultural production and rural economic development under the new situation. As China is a country with a large population and has a large demand for agricultural products every year, it is important to achieve a balance between supply and demand of agricultural products and stabilize the price of agricultural products for maintaining the balance of national development. Considering the current domestic and international environment faced by China, some developed countries take measures to control imports and exports and increase China's agricultural tariffs to realize the trade game, which increases the urgent situation of China's agricultural production and supply. In recent years, the production and supply of agricultural products have been limited by the impact of African swine fever, avian influenza and coronavirus. At present, China's agriculture has not fully resisted the strength of market risk. Only by further enhancing the resilience of the agricultural supply chain and forming a more balanced production and marketing relationship can small-scale production be relatively connected with the development of China's large market for thousands of households to a certain extent. In addition, a tough agricultural supply chain will encourage farmers to increase investment in agricultural production and promote the modernization of agricultural production, processing and sales. Therefore, under the current situation at home and abroad, improving the resilience of the agricultural supply

chain has important strategic significance to promote the development of agricultural industrialization.

4 Characteristics and Connotation of Resilience of Agricultural Product Supply Chain

Supply chain is a complex network composed of procurement, production, sales and logistics [8]. It involves a wide range of participants, such as suppliers, manufacturers, wholesalers, retailers, transportation enterprises, and airport operators. It organically combines upstream and downstream enterprises to provide products to customers in the shortest time and at the lowest cost. Generally speaking, agricultural product suppliers include all aspects from raw material supply to processing, packaging, logistics and distribution. From agricultural production to final consumption, the whole agricultural supply chain is mainly composed of suppliers, processors, wholesalers, sellers and consumers. This is a long and complex supply system, which needs to store and identify a large amount of information and data. In the process of agricultural industrialization, China’s agricultural supply system has gradually developed and matured. However, due to the complexity of the supply chain network, the supply chain is easy to be disturbed by the outside world and fluctuates or even imbalance. People call the ability of the system to quickly return to equilibrium in the face of impact and interference without changing its condition toughness (Fig. 1).

At the capability level, the toughness agricultural supply chain has strong prevention ability, response ability, absorption ability, recovery ability and learning ability. ① Prediction ability: it refers to a measure to predict the possible abnormal things during the operation of agricultural product supply chain and formulate measures to prevent accidents. Strong supply chain resilience is reflected in the ability to accurately predict the crisis and prepare response measures in advance, to make the time (t_1-t_0) between the arrival of the crisis and the emergence of negative effects longer and restrain the

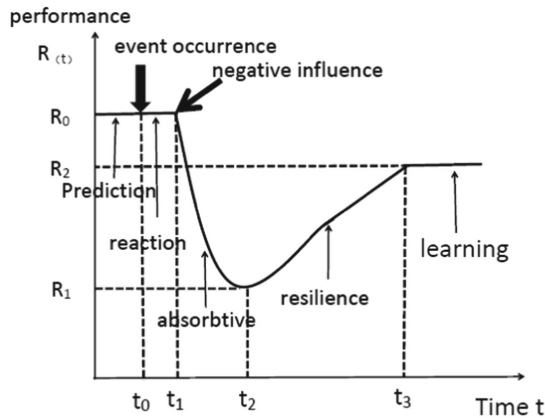


Fig. 1. Performance and capability performance of agricultural products supply chain after the event

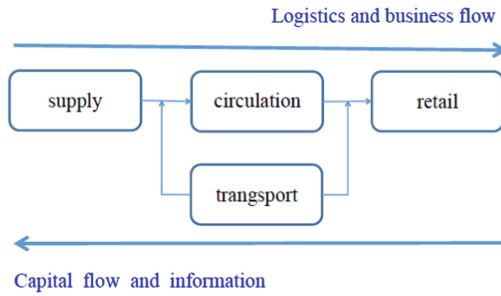


Fig. 2. Process of agricultural product supply chain

occurrence of negative effects to a greater extent. ② Reaction ability: refer to the agility, coordination and cooperation ability to quickly formulate treatment strategies and flexibly schedule resources according to environmental changes, quickly deal with business risks and reduce resource losses. ③ Absorptive capacity: it includes that enterprises can make flexible adjustments according to changes in the market environment. Farmers, logistics enterprises, distribution markets and customers in the agricultural supply chain share risks, coordinate and cooperate to maximize the interests of all parties, mitigate and stop negative impacts ($r1-r0$) and minimize the occurrence time of negative impacts ($t2-t1$) [3]. ④ Resilience: provide logistics distribution services and transportation support for the industry through logistics support. Take measures such as grain and oil collection and storage, fast-track transportation and strategic alliance of all main bodies of the supply chain, establish response plans, and quickly take remedial measures to maximize the performance of the supply chain and achieve a stable state. ⑤ Learning ability: refer to the ability of the supply chain to reflect and learn the whole event after returning to a stable state. Deepen the understanding of the industry through industry training and teaching, supply chain management and other methods, promote the sharing of achievements and knowledge resources among members, summarize coping experiences, and fully prevent the occurrence of the next similar event (Fig. 2).

In terms of performance, the resilience of agricultural products supply chain is reflected in whether it has a stable supply system, efficient transportation system, safe circulation system and convenient retail system. ① The supply system of agricultural products refers to the system that provides the source of agricultural products. Its toughness is mainly reflected in the quantity and distribution of supply sources, the inventory level of agricultural products and the supply volume of agricultural products. The agricultural supply chain with enough toughness can supply continuously and stably in the case of sudden changes in the environment, so the supply system is the core of the construction of the resilience of the agricultural supply chain. ② Transportation system is the capacity system needed for the movement of agricultural products in the operation of the agricultural supply chain. Its resilience is mainly reflected in whether it can form an effective reserve of multiple logistics resources, such as land transportation, air transportation, self-owned fleet, express delivery, complete vehicle, less than carload, etc.; and how to achieve the flexible switching between various logistics resources; whether there is a smooth transportation network; whether there is complete cold chain

transportation equipment. ③ The circulation system of agricultural products is based on technology. A good circulation mode and circulation system of agricultural products will greatly reduce costs, improve production efficiency and reduce consumption. The level of circulation efficiency is closely related to the product consumption, storage cost, supply and demand matching in the circulation process. After the circulation efficiency of agricultural products is improved, the consumption and logistics cost of products will be reduced, and the response sensitivity of the market will be improved, to increase the value of products and promote farmers' income and wealth. In today's society, people need more convenient, fast and high-quality consumption places and consumption methods. The guiding principle of setting up a more convenient and convenient way of agricultural products to meet the needs of consumers is that agricultural products should always be delivered to the hands of consumers through the establishment of a more convenient and convenient way of retail business, that is to say, agricultural products should always be delivered to the hands of consumers.

5 Countermeasures to Improve the Toughness of Agricultural Products Supply Chain

5.1 Establish Direct Supply and Direct Sales Channels for Agricultural Products

The establishment of direct supply and direct sales channels of agricultural products is the most powerful way to alleviate the excessive circulation links in China's agricultural market. From the enthusiasm for building direct supply and direct sales channels, direct supply and direct sales channels are very suitable for the construction of terminal retail stores. In some large chain stores in China, they have begun to try to purchase vegetables directly in some nearby rural areas, to purchase and sell vegetables in time, which not only ensures the quality of the goods sold, but also eliminates many commodities circulation operation links, thus greatly reducing the procurement cost of goods. With the rise of e-commerce, the establishment of online direct sales channels of agricultural products based on e-commerce has become more profitable. Compared with the traditional supermarket retail network, the online supplier platform has a wide audience and low sales cost, which is more suitable for establishing direct sales channels for agricultural products. At the same time, we should also actively develop farmers' direct selling agricultural product supply chain. In the "Internet + " era, e-commerce platforms will create greater opportunities for agricultural producers, effectively alleviate the problem of unsalable agricultural products, and promote the two-way flow of "online goods to the countryside" and "agricultural products to the city." Truly improve the efficiency of agricultural products and increase farmers' income. However, because farmers have limited power to master professional knowledge and new things, government departments or e-commerce enterprises should improve the publicity of the advantages of China's agricultural direct selling, improve agricultural policies, and guide farmers to participate in direct selling.

5.2 Accelerate the Improvement of Cold Chain Logistics Facilities

According to the cold chain logistics development plan for agricultural products, the state will guide and focus on investment in development projects including cold storage rooms, low-temperature logistics distribution centers, cold chain transport vehicles and refrigeration equipment. With the strong support of the state, the old refrigeration technology and thermal insulation machinery shall be eliminated in time, the whole process temperature control shall be carried out, the logistics loss of agricultural products shall be reduced, and the quick freezer and cold storage equipment to ensure the safety and quality of agricultural products shall be built. Adopt advanced automatic refrigeration technology and equipment, vacuum cooling technology, nondestructive testing, warehouse management and commercialized processing technology, automatic vehicle temperature control and other international leading science and technology to comprehensively modernize and improve mechanical equipment and enhance the ability of technological progress and innovation and development. In addition, we will vigorously cultivate several large and medium-sized cold chain transportation and logistics companies with strong economic strength, leading operation concept and management mode and strong core competitiveness, and promote the transformation to the third-party logistics mode with comprehensive logistics distribution system as the core. Promote large and medium-sized retailers to set up agricultural product logistics and distribution centers, and carry out third-party cold chain logistics services.

5.3 Promote the Construction of Informatization Level of Agricultural Product Supply Chain

Relying on the Internet of things environment, promoting the modernization of agricultural product information system platform, can also more efficiently promote the management and development of agricultural product supply chain. Through the development of agricultural product informatization, all participants in the supply chain management system can transfer product information more efficiently, to achieve the accuracy of data, covering the whole process of production, distribution, wholesale and retail. At the same time, by promoting the establishment of the third-party agricultural product information data center, it can also carry out the real-time monitoring and whole process control of the agricultural product supply system. Therefore, by using advanced communication technology based on traditional agricultural products supply chain management systems, the uncertainty and blindness of each link in the operation of traditional agricultural products supply chain can be reduced, to enhance the accuracy, timeliness and transparency of information management. Modern agricultural products supply chain management system ensures the smooth flow of information flow, capital flow, logistics and other information in the whole process. Modern agricultural products supply chain management system can make each node of the supply chain use information system to strengthen the coordination of various operations and realize the operation of the integration of production, supply and marketing, to reduce inventory backlog, enhance market response sensitivity and improve circulation efficiency [7].

5.4 Accelerate the Development of Agricultural Product Logistics Talent Team Construction

Cultivating high-quality professionals with advanced agricultural product knowledge and technology is the key issue in the development of modern agricultural product supply chain. Therefore, in the construction of agricultural product supply chain, we should strengthen the construction of talented team of agricultural product logistics. First of all, the producers and operators of agricultural products should not only improve the modern agricultural production technology, but also have the corresponding product management concept and market economy consciousness. Through the training and construction of such personnel, we can provide strong personnel guarantees for the development and growth of professional cooperative institutions of agricultural products, rural collective economic organizations, large professional farmers of planting and breeding, and agricultural products enterprises. Secondly, we should broaden the training channels, cultivate operation professionals and agricultural product logistics management personnel, and increase cooperation and communication with local colleges and universities. On the one hand, we should train the staff of relevant logistics enterprises in time, on the other hand, we should train local farmers and cultivate high-quality logistics talents with management skills and modern technology [4]. At the same time, we should strengthen the training of logistics e-commerce professionals, improve the connection of employees to the Internet and tap the potential of network agronomy. Give full play to the unique advantages of the industry and further promote the construction and improvement of agricultural product logistics system. Finally, through various incentives, students from local logistics universities are encouraged to join the agricultural product industry and provide expert support for the establishment of the agricultural system. The government can also use preferential policies to help college graduates and migrant workers return home to start businesses and attract more agricultural product logistics professionals.

5.5 Improve the Monitoring and Information System

Government departments should pay attention to building a scientific risk analysis and evaluation system to ensure the quality and safety of agricultural products. Government departments should support the construction and improvement of the corresponding system, actively guide and cultivate a talented team with basic risk analysis theory and corresponding professional knowledge, and invest a large amount of necessary financial support and advanced instruments and equipment to promote the research and development of risk analysis theory and technology and improve the development level of risk analysis theory and technology. Information and data should be obtained and managed through risk assessment. Extend the monitoring scope of the big data platform from the market to production and procurement, and establish an interconnected agricultural product safety traceability system covering the whole supply chain [9]. Promote the establishment of a series of traceability management chains from origin production - Logistics - agricultural products wholesale market distribution - retailer procurement. In addition, the government authorities should establish an agricultural product quality and safety information system and integrate it into the agricultural product market information system. Ensure timely and accurate delivery of information to those who need it. On

this basis, an open and transparent information disclosure mechanism for the quality and safety of agricultural products will be gradually formed, including the regular inspection report system for the quality and safety of agricultural products and the publicity system for the quality of agricultural products, the certification announcement system, the information publicity system for prohibiting and restricting agricultural products, the formulation and hearing system of technical standards for the quality and safety of agricultural products, etc.

6 Conclusions

With the frequent occurrence of emergencies in recent years, the supply and demand of agricultural products in China fluctuate continuously, which poses a serious threat to the orderly operation of the agricultural product supply chain. "Resilience of agricultural products supply chain" has attracted extensive attention from all walks of life. Agricultural products are the basic conditions for the survival of human society. Agricultural products themselves are easily affected and restricted by natural conditions such as season, timeliness and other irresistible factors. It is of great practical significance to study how to improve the prediction ability of agricultural products supply chain to emergencies, the response ability when events occur, the absorption ability to negative effects, the recovery ability after impact and the reflection ability of the whole process after recovery, and build a toughness agricultural products supply chain with stable supply system, efficient transportation system, safe circulation system and convenient retail system. From the perspective of "toughness supply chain", this paper analyzes the main problems existing in China's agricultural product supply chain, considers the necessity and urgency of building a toughness agricultural product supply chain, and puts forward the measurement method of agricultural product supply chain resilience and the promotion strategy in line with practical significance, which provides theoretical support for the realization of agricultural modernization under the new development pattern.

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