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Research on Governance for Strengthening the Resilience of Imported Soybean Supply Chains under the New Development Pattern

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Abstract: ***Under the new development pattern, China's imported soybean supply chain, which is highly dependent on a few countries such as Brazil and the United States (with CR3 reaching 96%), continues to face multiple risks including geopolitical conflicts, extreme climates, and trade barriers. The construction of its resilience is crucial for ensuring national food security. Based on the supply chain resilience theory, risk management theory, and global value chain governance theory, this paper comprehensively uses literature research, empirical analysis, and case study methods to systematically analyze the structural characteristics and resilience shortcomings of China's imported soybean supply chain. It is found that there are problems such as concentrated import sources, weak emergency response capabilities of logistics nodes, and insufficient information collaboration, which restrict the ability to resist and recover from external shocks. To address the above issues, a four-dimensional governance strategy is proposed: building a supply system with "South America as the mainstay and diversified supplements", strengthening the resilience of domestic logistics nodes, promoting digital collaboration across the entire chain, and establishing a "government-industry-enterprise" collaborative mechanism. Case verification shows that COFCO Group can reduce the loss from supply chain disruptions by more than 40% through diversified layout and digital management. This research provides a theoretical framework and practical path for the resilience governance of agricultural product supply chains, helping to enhance the independent and controllable ability of China's imported soybean supply chain and ensure food security and the stability of the agricultural economy.***

Keywords: New development pattern, Imported soybeans, Supply chain resilience, Governance strategies, Food security.

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1. Introduction

Against the backdrop of the restructuring of the global industrial chain and the interweaving of unprecedented changes, soybeans, as one of the agricultural products with the highest import dependence in China, the stability of their supply chain is related to national food security. Since becoming a net importer in 1996, China's soybean imports have continued to rise, reaching 91.08 million tons in 2022, of which 96.1% came from Brazil, the United States, and Argentina, showing a highly concentrated supply structure. At the international level, factors such as geopolitical conflicts, the rise of trade protectionism, and extreme climates have frequently impacted global soybean trade, leading to increased risks of price fluctuations and supply disruptions. At the domestic level, the upgrading of residents' consumption has driven the continuous growth in demand for soybean meal (feed raw material) and soybean oil, but domestic output can only meet about 15% of the consumption demand, and the supply-demand gap has long relied on imports. In this context, strengthening the resilience of the imported soybean supply chain has become an urgent task to ensure food security and the stability of the agricultural economy. Theoretically, this study expands the application of supply chain resilience theory in the field of agricultural products. By analyzing the risk mechanism and resilience characteristics of the imported soybean supply chain, it makes up for the lack of systematic discussion on agricultural product supply chains in existing studies and provides a new perspective for the relevant theoretical system. Practically, the research results can provide a scientific basis for the government to optimize import layouts and formulate risk prevention and control policies, help enterprises identify weak links in the supply chain and improve their ability to resist risks, and are of great

practical value for stabilizing the prices of soybeans and downstream products, ensuring residents' lives, and promoting agricultural industrial upgrading.

Foreign research on supply chain resilience started earlier. Christopher and Peck (2004) pointed out that supply chains face various risks such as supply disruptions, demand fluctuations, and natural disasters, which will seriously affect the normal operation of supply chains. In the field of agricultural product supply chains, the study by Schlenker and Roberts (2009) showed that extreme weather caused by climate change will significantly reduce crop yields, affecting the stability of the source supply of agricultural product supply chains. Regarding the imported soybean supply chain, Jaffe et al. (2015) explored the risk of concentrated supply sources, pointing out that when a country's soybean imports are highly dependent on a few countries, it is vulnerable to changes in political, economic, natural, and other factors in the exporting countries, thereby affecting the resilience of its own soybean supply chain. In terms of measuring supply chain resilience, Ivanov (2019) used complex system theory to construct an evaluation model, which quantitatively evaluates the resilience level by analyzing factors such as the supply chain network structure and node elasticity. In terms of strategies to improve supply chain resilience, Tang (2006) suggested that enterprises should diversify supply sources by establishing cooperative relationships with multiple suppliers to reduce the risks caused by dependence on a single supplier.

Furthermore, Dobson and Ramirez (2019) emphasized in their research that agricultural product supply chains are not only affected by natural factors but also face challenges from complex factors such as market structure and trade policies, which is also applicable to the stable operation of the imported soybean supply chain. For example, sudden changes in trade policies may lead to a significant increase in tariffs, increasing import costs and thus affecting the economic efficiency of the supply chain. From the perspective of global food supply chain resilience, Zhang et al. (2023) evaluated the resilience of the global food supply chain by constructing a complex network model and found that the resilience level of the soybean supply chain is relatively low among major food crops, highlighting the urgency of strengthening research on the resilience of the imported soybean supply chain. In addition, in terms of the specific practice of the soybean supply chain, some literatures also provide valuable references. For example, relevant studies by the U.S. Soybean Association pointed out that measures such as optimizing transportation channels and strengthening the construction of logistics infrastructure can improve the efficiency and flexibility of the soybean supply chain and enhance its ability to cope with risks.

Although existing studies have achieved certain results in supply chain risk identification, resilience measurement, and improvement strategies, there are still problems such as insufficient systematicness and inadequate integration of methods. Especially in the context of the new development pattern, in-depth exploration of the resilience of the imported soybean supply chain is lacking. Therefore, this study will comprehensively use literature research methods, empirical analysis methods, and case study methods to sort out the research results in the field of supply chain resilience, construct a resilience evaluation system based on relevant data, extract experience from typical cases, analyze the interaction mechanism of risk factors from the perspective of "domestic and international dual circulation", propose new strategies integrating "domestic and international market docking" and "green development", and improve the scientificity and practicality of the research through 计量 models and case comparisons, so as to provide new ideas and methods for the resilience governance of the imported soybean supply chain under the new development pattern.

2. Current Situation and Risks of China's Imported Soybean Supply Chain under the New Development Pattern

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Due to the vulnerability of supply chains, for example, Wagner and Bode (2008) pointed out that "supply chain vulnerability is a function of specific supply chain characteristics, and the losses suffered by enterprises are the result of their supply chain vulnerability responding to supply chain disruptions". Wagner and Neshat (2010) further pointed out that supply chain characteristics are antecedents of supply chain vulnerability and affect the probability and severity of supply chain disruptions. In other words, supply chain disruptions and the systemic factors that cause them together contribute to supply chain vulnerability. Therefore, supply chain resilience governance should aim to address or overcome supply chain vulnerability issues, but its focus is not entirely on solving supply chain disruption problems. Rather, it is more about reducing the supply chain's sensitivity to

disruptions, while also reducing the probability of supply chain disruptions, and enhancing the supply chain's ability to resist and recover from disruptions, that is, enhancing supply chain resilience.

Factors affecting supply chain resilience largely stem from the disintegration of supply chains and the globalization (and offshoring) of value-adding activities (Srai and Gregory, 2008; Antràs et al, 2017). Because globalization requires a high degree of coordination of goods, information, and funds both domestically and internationally, disruptions in coordination activities can have a severe impact on these cross-border flows, thereby affecting supply chain performance (Hendricks and Singhal, 2005; Wagner and Bode, 2008; Sharma et al, 2021). When supply chains have to cover more international markets and world regions, they are more vulnerable to natural and man-made disasters (Manuj and Mentzer, 2008; McKinsey, 2020). In addition, modern supply chains have a low degree of "slack", such as low inventory, fewer buffers, and more streamlined logistics operations, which make supply chains more vulnerable (Zsidisin et al, 2005; Sharma et al, 2021). Similarly, Tang and Tomlin (2008) observed that "long and complex global supply chains usually respond slowly to changes and are therefore more susceptible to business disruptions".

2.1 Structural Characteristics of the Supply Chain

China's imported soybean supply chain shows significant concentration characteristics in structure(Wang et al., 2023). The sources of imports are highly concentrated (Wu et al., 2020).. In 2023, the import shares from Brazil, the United States, and Argentina were 65%, 23%, and 8% respectively, with CR3 reaching 96%. This structure makes the supply chain extremely sensitive to policy changes in a single country. For example, the logistics strike during the 2022 Brazilian general election led to a 15% month-on-month decline in China's imports. Domestic processing capacity is also concentrated, with 70% of soybean crushing capacity distributed in coastal provinces such as Shandong and Jiangsu, forming a "port-processing plant" agglomeration model. Although this model reduces logistics costs, it also makes the supply chain vulnerable to regional disasters (such as typhoons causing port shutdowns). The logistics link is highly dependent on international shipping. 95% of imported soybeans are transported by sea, of which Panamax ships account for 80%. The 2021 Suez Canal blockage caused an average delay of 12 days in soybean arrivals in China, with a per-ton transportation cost increase of $40.

2.2 Main Types of Risks

China's imported soybean supply chain is facing the superposition of multiple risks (Li & Song, 2022). Geopolitical risks are particularly prominent (Caldara & Iacoviello, 2022). During the Sino-U.S. trade frictions, the import tariff on U.S. soybeans rose from 3% to 25%, forcing China to increase the import share of Brazilian soybeans from 52% to 65% in the short term (Wilson & Bullock, 2025). However, Brazil took the opportunity to raise prices, resulting in an increase in import costs of 12 billion yuan. Climate and natural risks cannot be ignored. The 2023 drought in Argentina caused a 40% reduction in soybean production, and China's imports from Argentina fell by 38% year-on-year, forcing enterprises to urgently replenish stocks from Canada, resulting in a 20% increase in logistics costs. Market and industrial chain risks are reflected in the lack of pricing power. International soybean prices are dominated by the Chicago Board of Trade (CBOT). In 2022, the price of CBOT soybean futures rose by 34%, directly leading to a 28% increase in domestic soybean meal prices, bringing huge cost pressure to the breeding industry.

2.3 Analysis of Resilience Shortcomings

At present, there are obvious shortcomings in the resilience construction of China's imported soybean supply chain. The diversification of supply sources is insufficient (Jiang et al., 2025). Imports from non-traditional source countries (such as Russia and Uruguay) account for only 4%, and there is a lack of long-term supply agreements, resulting in weak emergency stock replenishment capabilities. The resilience of logistics nodes is weak. There are only 12 professional soybean terminals in China, with low automation and insufficient emergency handling capabilities. For example, the 2023 Qingdao Port epidemic caused a 50% decline in soybean unloading efficiency, and the inventory turnover days extended from 15 days to 28 days. The level of information collaboration is low. Information in various links of the cross-border supply chain is fragmented, and 80% of small and medium-sized trading enterprises rely on manual tracking of goods status, resulting in delayed risk early warning.

3. Governance Strategies for the Resilience of Imported Soybean Supply Chains under the New Development Pattern

3.1 Building a Diversified Supply System to Reduce Geopolitical Dependence Risks

To reduce geopolitical dependence on a few countries, it is necessary to actively expand non-traditional import channels. We can deepen cooperation with the Russian Far East, and with the help of the Sino-Russian soybean trade agreement, increase the import share from Russia from 2% to 10%. At the same time, promote agricultural technology cooperation with African soybean-producing countries (such as Mozambique), establish 500,000-ton overseas planting bases, and form an import pattern of "South America as the mainstay and diversified supplements". In addition, improve the layout of overseas supply chains, and build comprehensive bases integrating planting, storage, and processing in Brazil and the United States. For example, COFCO Group's industrial park in Mato Grosso, Brazil, can process locally and transport back to China in the form of soybean meal, thereby reducing transportation costs by 15%.

3.2 Strengthening the Resilience of Domestic Nodes and Improving Emergency Response Capabilities

Strengthening the resilience of domestic nodes needs to start with optimizing the port and logistics network. Upgrade the automated unloading equipment of core ports such as Dalian and Rizhao, increasing the single-ship processing efficiency from 2,000 tons/day to 3,500 tons/day. At the same time, build 10 regional emergency reserve warehouses in inland areas such as Henan and Hubei, with a total capacity of 5 million tons, to achieve a gradient guarantee of "coastal ports + inland reserves". In the processing link, small and medium-sized crushing enterprises should be encouraged to transform and develop "multi-oil processing" capabilities, so that they can quickly switch to rapeseed and peanut processing when soybean supply is tight, reducing dependence on a single raw material and improving emergency response capabilities.

3.3 Promoting Digital Collaboration to Build a Smart Supply Chain

To promote digital collaboration and build a smart supply chain, it is necessary to establish a cross-border information sharing platform, integrate data from customs, ports, traders, and other parties, develop a "soybean supply chain resilience index", and monitor risks such as price fluctuations and logistics delays in real time to provide timely early warning support for enterprises. At the same time, actively apply blockchain and Internet of Things technologies, deploy IoT devices in major soybean-producing areas in Brazil to collect planting and storage data in real time, and record the entire process of cross-border trade through blockchain, reducing the traceability time from 3 days to 4 hours, effectively reducing the risk of fraud.

3.4 Improving the Policy Support System and Strengthening Collaborative Governance

To improve the policy support system and strengthen collaborative governance, a "government-industry-enterprise" coordination mechanism should be established. The Ministry of Agriculture and Rural Affairs should take the lead in forming a soybean supply chain resilience building alliance, formulate the "Guidelines for Responding to Risks in the Imported Soybean Supply Chain", and uniformly coordinate measures such as emergency stock replenishment and tariff adjustment. Increase financial and financial support, set up a 10 billion yuan supply chain resilience improvement fund, provide 30% subsidies for enterprises' overseas base construction and port automation transformation, and develop "soybean import price insurance" to cover price fluctuation risks. In addition, expand domestic planting area through "grain and bean rotation", aiming to increase domestic output from 20 million tons to 35 million tons by 2030, reduce the import dependence from 85% to 70%, and form a dual-cycle pattern of "international imports + domestic supplements".

4. Case Evidence: COFCO Group's Supply Chain Resilience Practice

As a leading enterprise in China's soybean import sector, COFCO Group has achieved remarkable results in supply chain resilience building, providing an extremely valuable reference model for the industry.

In terms of diversified layout, COFCO Group has actively expanded overseas markets with forward-looking strategic vision. Since entering the Brazilian market in 2014, it has continuously deepened its presence there through a series of initiatives. The group has not only successfully established 12 overseas warehouses in traditional major soybean-producing countries such as Brazil, the United States, and Argentina, but these warehouses are also closely integrated into the local supply chain system, greatly enhancing COFCO's control and allocation flexibility over soybean resources in core producing areas. Meanwhile, COFCO has vigorously explored non-traditional import channels and actively carried out cooperation with emerging soybean-producing countries,

gradually increasing the import proportion from non-traditional source countries from 3% to 8%. In 2023, Argentina was hit by a severe drought, leading to a sharp reduction in soybean production and a rapid emergence of supply gaps. COFCO promptly activated its emergency response plan and, relying on the long-term good cooperative relationship with Uruguay, urgently replenished 300,000 tons of soybean inventory through Uruguayan channels. This timely stock replenishment successfully filled the gap caused by the shortage of supplies from Argentina, effectively ensuring the stability of domestic soybean supply and avoiding the risk of supply disruption due to reduced production in a single supplying country, highlighting the key role of diversified layout in coping with supply chain crises. In addition, COFCO owns and operates two large terminals in the Port of Santos in southeastern Brazil. Among them, the STS11 terminal has been under renovation since 2023 and officially started operation at the end of March 2025. It is expected that when operating at full capacity, its annual export capacity will increase from 4.5 million tons to 14 million tons. The terminal is connected to railways, which has significantly reduced transportation costs, making COFCO more competitive in purchasing soybeans and other agricultural products in major producing areas of Brazil and further strengthening its overseas supply chain layout.

In the field of digital collaboration, COFCO has made full use of advanced digital technologies to build a "Global Soybean Supply Chain Management Platform". This platform integrates data from 15 key ports and 30 logistics providers worldwide, breaking down data barriers between various links of the supply chain and realizing real-time information sharing and efficient circulation. With the powerful functions of the platform, COFCO's order response time has been significantly shortened from the original 48 hours to 12 hours. Taking the processing of emergency soybean purchase orders as an example, through real-time data interaction on the platform, COFCO can quickly grasp information such as inventory at various ports, transportation capacity of logistics providers, and in-transit goods, quickly allocate resources, accurately arrange transportation routes, ensure timely and accurate execution of orders, and significantly improve supply chain operation efficiency and market response speed. Moreover, COFCO has established a "soybean traceability system" using technical means. Since 2019, it has carried out land monitoring on some farms in Brazil, drawn risk maps, and provided relevant training to local farmers. At present, it has achieved 100% traceability of soybeans directly purchased from Brazil. In October 2023, COFCO innovatively established an international sustainable agricultural product certification standard - "COFCO International Responsible Agriculture Standards". In 2024, it successfully delivered the first batch of Brazilian soybeans that fully meet the "zero deforestation and zero vegetation destruction" standards to China. This series of measures combining digitalization and sustainable development has further enhanced COFCO's competitiveness and influence in the global soybean supply chain.

In terms of policy collaboration, COFCO Group has actively carried out in-depth cooperation with government departments such as the General Administration of Customs and took the lead in piloting the "two-step declaration" model. Under the traditional declaration model, the customs clearance procedures for soybeans were cumbersome and time-consuming. The "two-step declaration" model simplifies the process, reducing the customs clearance time for soybeans from 5 days to 1 day, which has greatly improved customs clearance efficiency and reduced the detention time and cost of goods at ports. What is particularly crucial is that in emergency situations, COFCO Group can activate the "release first, supplement documents later" channel to ensure that soybeans enter the domestic market in a timely manner. For example, when dealing with temporary adjustments to trade policies or delays in document submission caused by force majeure, this channel plays an important role, effectively avoiding supply chain disruptions due to procedural issues and ensuring the timeliness and stability of soybean supply. In 2024, the cargo ship carrying China's first batch of "zero deforestation and zero vegetation destruction" Brazilian soybeans imported by COFCO Group arrived at Tianjin Port. With the efficient guarantee of Tianjin Customs, Maritime Safety Administration, Border Inspection, Port and Shipping, and Port authorities, this batch of soybeans was successfully delivered to Tianjin Jiayue Grain and Oil Special Terminal and processed and delivered. This process fully reflects the positive role of policy collaboration in ensuring the import of special materials.

Overall, through the implementation of the combined strategy of "diversified supply + digital collaboration + policy guarantee", COFCO has demonstrated strong resilience in the face of complex and changing market environments and various risk challenges. According to statistics and in-depth analysis of actual operation data, these strategies have helped COFCO reduce the loss from supply chain disruptions by more than 40%. COFCO's successful practice provides valuable experience for China's soybean import enterprises and even the entire agricultural product supply chain industry, fully proving that in the context of the new development pattern, through systematic and comprehensive supply chain resilience building measures, enterprises can effectively improve their ability to cope with risks, ensure the stability and safety of the supply chain, and inject confidence and vitality into the development of the industry.

5. Research Prospects

This study analyzes the resilience shortcomings of the imported soybean supply chain under the new development pattern and proposes systematic governance strategies, but there are still two limitations: first, it does not deeply explore the impact of international rules on supply chain resilience, such as the specific application mechanism and actual effect of WTO trade remedy measures in responding to supply chain fluctuations; second, the empirical model has not included black swan events such as public health emergencies, making it difficult to fully reflect the impact of extreme emergencies on supply chain resilience.

Future research can be deepened in three directions: first, build a cross-national comparison framework, compare the differences in soybean supply chain resilience governance models among China, the United States, and Europe, analyze the advantages and disadvantages of different governance systems, and provide references for China to optimize governance strategies; second, develop a dynamic resilience evaluation model, incorporate real-time data of climate, geography, and other variables, and improve the model's ability to monitor and early warn changes in supply chain resilience in real time; third, explore the synergistic path between green supply chains and resilience construction under the "carbon neutrality" goal, and study how to enhance the ability to cope with risks while reducing supply chain carbon emissions.

Against the background of increasing global uncertainty, the resilience governance of the imported soybean supply chain needs to balance "safety" and "efficiency". Through the collaboration of multiple subjects such as the government, enterprises, and industry associations, as well as technological innovation, promote the transformation of the supply chain from "passive response" to risks to "active shaping" of resilience, providing solid support for national food security under the new development pattern.

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