

Risk Mitigation Strategies in the Post-Pandemic Supply Chain Era: A Case Study of Food Cold Chain Logistics (FCCL)

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Abstract. The COVID-19 outbreak has had great impacts on traditional trading activities and lifestyles. More and more consumers choose to shop on online platforms, which requires more efficient management of supply chains. Sellers face real problems, such as maintaining a stable and reliable supply chain and avoiding the risk of supply chain disruption. There has been some research on supply chains, but they mainly focus on upgrades, digitalization, business collaboration efficiency improvement, etc. Few have paid attention to the causes of supply chain disruption and how to avoid the risk. In this regard, this article aims to summarize the actual risks that can be found in the operation of a supply chain, taking a cold chain in the food supply as an example, in the background of the digital economy, and to put forward some ideas and suggestions for avoiding such risks. The research presented in this article will help to reveal the potential risks of supply chain disruption and provide some inspiration for improving the resilience and anti-risk capabilities of the supply chain.

Keywords: Food Cold Chain Logistics, Risk Mitigation Strategies, Post-Pandemic.

1. Introduction

As an important link to food safety, the FCCL industry bears the important task of transporting food from the production place to the consumption end. However, in the post-pandemic era, the risk of supply chain disruption has increased significantly, which has become an important limiting factor to developing China's FCCL industry. Data shows the loss rates of China's grain, vegetables, and fruits after production is between 7%-11%, 15%-20%, and 20%-25%, respectively [1]. This has caused serious economic losses and huge waste. On the one hand, with the ease of restrictions at the state level, some local blockage and control measures are still in effect, resulting in delays in logistics and transportation. On the other hand, the vigorous recovery of China's economy and consumer demand in the post-pandemic era has also made it even more complex to manage a supply chain [2, 3]. These are all contributing factors to increased supply chain disruption risks in FCCL.

As a typical example in the supply chain industry, the FCCL clearly shows the complexity and diversity of the causes of risks it is faced with. In "Food Safety Risk Management in the Post-pandemic Era from the Perspective of Supply Chain," the food supply chain is a chain structure with highly decentralized and complex characteristics. The food supply chain involves various stakeholders, including raw material suppliers, food processors, manufacturers, distributors, logistics companies, retailers, governments, social organizations, and consumers [4, 5]. Therefore, firstly, there is a high degree of dependence between various links in the FCCL industry. Sometimes, the complexity of a supply chain can seriously damage its efficiency. For example, food manufacturers need suppliers to provide raw materials for processing. At the same time, wholesalers also need manufacturers to provide enough products to ensure the stability of their supply, and retailers, in turn, rely on wholesalers to supply products. Any delay or disruption at any of those links, due to the quality of the product itself or external disturbance, would put the whole supply chain in danger or even make it collapse in the end. Secondly, an unstable external environment is also an important factor that would add the risk of supply chain interruption at this stage, such as traffic congestion, natural disasters, possible lockdowns, and restrictions for disease prevention and control, which may delay the transportation of food. Climate change and the natural disasters it may bring about could seriously damage the chain equipment, making it impossible to store the food in the appropriate temperature or humidity, thus resulting in loss. Equipment failure is also a possible cause of food

deterioration, which prevents many suppliers from delivering sufficient and high-quality raw materials or food products. Therefore, the structural inefficiency in management caused by its complexity and the inevitable external disturbance in the post-pandemic era are two key factors that must be studied when researching the post-epidemic FCCL.

2. Analysis on causes

2.1. External Factors

China's food supply chain is faced with many severe external disturbing factors. Although the WHO has ended its PHEIC declaration on the COVID-19 pandemic, reports of new cases still can be seen now and then in various regions. Moreover, as the responding policies vary between regions or countries, the supply chain disruptions caused by them also keep changing.

First of all, the greatest impact comes from the restriction on traffic for disease prevention and control. In such cases, vehicles are limited or even banned on roads. The situation would be even worse when local authorities announce a lockdown in the whole area. These measures could cause delays or disruptions in the transportation of raw materials or products in the food cold chain, making it difficult for the goods to reach their destination. Sometimes, the goods are perishable, such as seafood and fruits. If they have to accept frequent screening to ensure food safety, it would undoubtedly increase the time of food cold chain transportation and the quarantine costs that companies need to pay. Besides, it becomes more difficult to predict the recurrence of epidemics in various places in a post-pandemic era, which will also impact the inventory management strategy of the food cold chain. Due to the uncertainty of pandemic control policies, companies that need to adjust their inventory management strategies promptly may need to be able to guarantee sufficient inventory or have a considerable backlog of goods that cannot be sold, increasing the risk of disruptions in supply chains.

Secondly, the COVID-19 pandemic has also rebuilt the purchasing patterns of consumers and the supply-and-demand patterns in the market. Restriction measures during the pandemic may have a certain impact on consumers' shopping habits. For example, people tend to shop online instead of buying food in physical stores, which requires companies to adjust their supply chain structure flexibly to avoid supply chain disruptions.

In addition to the background of a global pandemic, extreme weather followed by natural disasters, such as tsunamis and earthquakes, are also possible causes of disruptions in FCCL. Risks caused by natural disasters are mainly related to the operation of companies, and they could be classified as financial risks, including those caused by emergencies like economic crises [6]. Severe weather conditions and natural disasters are most likely to cause traffic disruptions, such as road congestion, flight delays, airport closures, or bridge damage. It will block the food cold chain, preventing the goods from reaching the destination in time, and may even lead to food spoilage or expiration. Natural disasters may also change the needs of residents in the area and those around it. Sometimes, it may cause panic buying of food or the need for large-scale food assistance in disaster-stricken areas. If it happens, the companies must adjust their supply chains in time to cope with supply and demand fluctuations to avoid food cold chain disruptions. And there might be a relatively extreme situation under which the warehouse storing cold chain food happens to be located in the hit area. It is extremely possible to suffer damages to the storage facilities and loss of inventory goods. In such cases, the availability and stability of the supply chain will inevitably be affected.

In summary, external factors, including inventory and transportation, may impact various links of FCCL.

2.2. Internal Factors

In addition to unexpected factors and policy influences outside the industry, many problems within the FCCL are also important causes for disrupting its supply chain.

First, at the current stage, China still needs to have standard guidelines to regulate the FCCL industry. This has led to endless management problems for many companies and made them unable to quickly adapt to innovation and development within the industry [7]. Even now, when the COVID-19 pandemic has dramatically changed the public's shopping habits, the informatization of the FCCL industry has not seen substantial improvement. The fact that many companies still stick to traditional business models and have not established stable and mature supply chains with large online platforms and retailers selling on their websites does not meet the requirement for FCCL innovation and development [8]. At the same time, the supply chain of FCCL is quite complicated. It's a long process involving several or even dozens of different parties, from purchasing raw materials to food processing to retail distribution and then to consumers. Many companies have no targeted supply chains in FCCL operations. Moreover, due to the lack of sound management and working standards, the cost of FCCL remains high, while the profits are often unsatisfying. There are also broken chains due to the lack of effective regulations or control caused by the above reasons [9].

Secondly, the lack of technology due to management deficiencies has also hindered the development of China's FCCL industry, making it hard to keep up with the extremely rapid expansion after the pandemic, which has resulted in transportation efficiency falling behind the factory capacity, creating redundant capacity and wasting resources and raw materials. Many problems in FCCL management and technology reflect the current situation of insufficient talent reserves for management in the industry. Compared to developed economies, such as the EU and the United States, China's FCCL started relatively late and has unique problems aggravated during the persisting pandemic. Among them, the most crucial is the severe shortage of management personnel specialized in FCCL. The industry requires many logistics, warehousing, and distribution personnel to ensure the smooth operation of the entire supply chain. However, the existing workforce is quite limited. It isn't easy to support the operation of a sophisticated supply chain. Some links, such as transportation and sales, may be disrupted due to insufficient human resources. For example, logistics and transportation in China's south-eastern coastal areas have suffered periodic shortages due to the impact on the free movement of people and the labor market caused by lockdowns and restrictions during the pandemic. An article titled "Risk Management and Control of Enterprise Supply Chains in the Post-pandemic Era" mentions that human resources manufacturing in the southeastern coastal areas relies heavily on inland provinces. Due to the impact of the pandemic, many migrant workers could not return to factories, resulting in a huge labor gap [10]. At the same time, information asymmetry occurs due to the complexity of the food cold chain and the lack of information sharing between various links. For example, food manufacturers may not be able to understand the raw material suppliers' inventory status accurately. The wholesalers may not be able to keep up with the manufacturers' production plan, and the retailers may not be able to know the wholesalers' supply capacity. All these may lead to an increased risk of supply chain disruption.

3. Suggestions

In response to the above existing problems, the following solutions are recommendable. The first is establishing cooperative relationships with multiple suppliers to reduce the risk of a single supply chain. When one supplier in one of the supply chains cannot supply, one can promptly switch to other suppliers to ensure the continuity of the supply chain. Other similar problems can also be solved in this way. At the same time, it is necessary to establish multiple supply chains that are resilient enough to meet special requirements from customers and to support customization in sales and promotion activities to facilitate the introduction of new products and the recall of faulty products [10].

Secondly, it is important to use advanced logistics technology and equipment in FCCL, such as drones, intelligent vehicles, etc., which not only improves the efficiency of the supply chain but also reduces the need for personnel to a certain extent. In this way, it will also promote the risk of supply chain disruption, which the automatization of transportation could reduce.

In the meantime, to solve the problem of chain disruption caused by insufficient information sharing in FCCL, transparent, efficient and secure information-based digital platforms are what the FCCL companies should focus on. In the post-pandemic context, global economic cooperation and trade exchanges continue to go deeper, while digital technologies such as big data, artificial intelligence, and cloud computing keep developing. As the digital economy grows, new technologies affect nearly all aspects of our daily lives. In this sense, the efficiency and continuity of supply chains can be greatly improved by establishing an efficient and secure digital platform to help enterprises manage the supply chains, monitoring and locating the direction of logistics and transportation in real-time, keeping every detail in the supply chain in control, and providing consumers with an excellent consuming and shopping platform.

In addition to improving the application of supply chain technology and its management system, it is also important to conduct regular maintenance and inspection of refrigeration, freezing and fresh-keeping equipment to ensure their operation. Some other basic maintenance work is also needed to reduce the possibility of equipment failure and reduce the risk of supply chain disruption. To ease the impact of different policies made by local governments on corporate logistics, companies can cooperate with government departments through economic cooperation and other methods to solve the problems in transportation and other aspects of FCCL. In the "Letter on the Reply to Proposal No. 1274 (Economic Development Category No. 155) of the Fourth Session of the 13th National Committee for the CPPCC ", it is mentioned that "according to the Ministry of Agriculture and Rural Affairs, the Ministry of Commerce and the Ministry of Transport's consulting results, the Ministry of Agriculture and Rural Affairs plans to steadily promote the construction of agricultural product warehousing insurance cold chain logistics facilities, and also promote the high-quality development of the agricultural product cold chain logistics industry; the Ministry of Commerce plans to make efforts in strengthening the construction of agricultural product cold chain infrastructure and cultivating key cold chain logistics enterprises, in order to enhance the development of cold chain logistics; the Ministry of Transport plans to improve the logistics facility network and the technical level of cold chain transportation equipment, and also improve cold chain transportation standards and specifications while strengthening the tracking of cold chain logistics data in the industry.

Finally, in the face of external risks, especially those brought about by natural disasters caused by climate change and other reasons, companies should conduct relevant surveys on the affected area and commodity demand, preparing themselves for possible expansion or reduction in production to lower the chance of a supply chain disruption caused by the fluctuations in the supply and demand in disaster areas.

In summary, the risk of supply chain disruption has had a significant impact on the FCCL industry. Still, it could be reduced by diversifying the chain, strengthening information sharing, and improving logistics and transportation efficiency to ensure food safety and people's health. The FCCL industry needs to strengthen supply chain management further and improve its resilience and flexibility to adapt to changes in demand in the post-pandemic era.

4. Conclusion

In the post-epidemic era, the food cold chain logistics (FCCL) industry faces increasing risks of supply chain disruptions, which have become a major constraint to developing the FCCL industry in China. The causes of these risks include supply chain complexity and external disruptions. Therefore, this study recommends the following measures to mitigate these risks: diversify the supply chain, increase information sharing, improve logistics efficiency, promote digital platforms, and enhance equipment maintenance. This will help ensure food safety and people's health and enable the FCCL industry to better adapt to the changing demands of the post-outbreak era.

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