



Research on Green Supply Chain Management and Development Strategy of Fresh Products in Liaoning Province

Jun Wan¹ and Zhengwen Ren^{2*}

¹Department of Basic Teaching, Liaoning Technical University, Huludao 125105, China

²School of Business Administration, Liaoning Technical University, Huludao 125105, China

*1156805977@qq.com

Abstract. This paper provides a comprehensive study on the current status of green supply chain management of fresh produce and its development strategies in Liaoning Province. Using SWOT analysis, the strengths, weaknesses, potential opportunities and challenges of the supply chain of fresh produce in Liaoning Province are thoroughly analyzed, and accordingly, a series of strategies are proposed to optimize the supply chain efficiency and enhance its green development potential. The study shows that Liaoning Province has obvious advantages in terms of policy support and enhanced use of science and technology, but at the same time, it faces disadvantages such as uneven infrastructure development and low efficiency in logistics and distribution. To meet these challenges and seize new opportunities in the fresh produce market, this paper suggests strengthening the construction and standardization of infrastructure, upgrading technological innovation and information management, integrating resources and optimizing the industry chain structure, broadening financing channels and strengthening risk management, expanding domestic and international markets through e-commerce, and integrating green development and consumption upgrading needs. The implementation of these strategies can promote the green supply chain of fresh produce in Liaoning Province to develop in a more efficient and sustainable direction.

Keywords: green supply chain, fresh produce, Liaoning Province, supply chain management, SWOT analysis.

1 INTRODUCTION

Under the advocacy of green consumption and the promotion of green and low-carbon lifestyle, people's demand for high-quality green fresh products is increasing. China Cold Chain Logistics Status and Development Trend" shows that 50% of perishable food products in China need cold chain transportation, but the comprehensive cold chain circulation rate is only 19%. In order to avoid causing resource waste and supply chain blockage, it is imminent to create a green supply chain for fresh products based on the green supply chain to improve the quality of fresh products.

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With the development of the economy and the increase of income, the consumption level of the population has been increasing. Along the upgrading of consumption structure and expansion of consumption scale, people are increasingly concerned about the safety and freshness of food [1]. While meeting these growing demands, green supply chain management (GSCM) has become a core strategy for companies to achieve sustainable development [2], which assists companies to achieve a balance between financial and environmental performance through eco-friendly operational practices [3]. For firms in Liaoning Province, the adoption of GSCM becomes crucial in the trend of increasing public awareness of environmental protection and rising demand for green products. In this regard, firms need to strive to find a balance between investment in technological innovation and cost-effectiveness [4], and utilize efficient technology and information flow management to enhance overall supply chain competitiveness and eco-performance [5].

On the technology-driven side, innovations such as blockchain, big data and 5G are seen as key factors in building efficient and transparent supply chains [6]. Liaoning province should capitalize on this opportunity and utilize advanced technologies to continuously improve the fresh produce supply chain, especially in terms of monitoring and tracking [7]. At the same time, it is crucial to strengthen the transfer and sharing of environmental management knowledge throughout the supply chain, which can help realize cost savings and synergies [8]. Liaoning Province needs to make more progress in improving the standardization of the fresh produce industry, especially in terms of facilities and operational processes. With the popularization of environmental protection knowledge, companies are increasingly concerned about reducing resource consumption and waste generation, and are committed to producing higher quality green goods [9].

Although GSCM has been widely studied globally, there is still a relative lack of research on Liaoning Province. As an important agricultural and industrial base in Northeast China, Liaoning Province faces unique challenges and opportunities in its fresh produce supply chain. This study aims to fill this gap by conducting an in-depth SWOT analysis of the fresh produce supply chain in Liaoning Province and proposing targeted development strategies to promote its development in a more efficient and sustainable direction.

2 SWOT ANALYSIS OF LIAONING FRESH PRODUCE SUPPLY CHAIN

2.1 Advantages

(1) Policy support in Liaoning Province.

Liaoning Province is actively building cold chain logistics infrastructure, planning to create 2-3 national backbone cold chain logistics bases, as well as about 100 production and marketing cold chain distribution centers and 2,000 origin cold storage and preservation facilities. This layout can significantly improve the circulation efficiency

of fresh products and safeguard the products to reduce loss and waste during transportation.

(2) Improvement of development quality.

Liaoning Province has enhanced the service capacity of the cold chain logistics system by improving the scale organization efficiency of cold chain logistics and continuously improving the level of technology and equipment. Focusing on the trend of digitalization and intelligence

(3) Improved level of supervision.

Liaoning Province is establishing a diversified supervision mechanism that includes government supervision, enterprise self-management, industry self-regulation and social supervision. The whole process monitoring and supervision system and closed-loop management have been strengthened.

(4) Enhanced use of science and technology.

Liaoning Province has actively utilized the development of science and technology, such as logistics technology, cold chain technology, green supplier management technology, etc., to provide a technological foundation for building a smarter, more efficient and sustainable green supply chain management system.

(5) Increased participation in e-commerce.

E-commerce participation in Liaoning Province has been increasing, and the development of fresh food e-commerce is in good shape. By camping diverse online shopping platforms, such as front warehouses, O2O platforms, community group purchases and other modes, the market penetration of fresh products and consumers' purchasing convenience have been effectively enhanced. As shown in Table 1, the historical data chart of fresh food logistics demand in Liaoning Province demonstrates the steady growth of market demand for the supply chain of fresh products in Liaoning Province, which provides a solid foundation for the further development of e-commerce and supply chain management.

Table 1. Liaoning Fresh Food Logistics Demand.

Year	Demanded	Year	Demanded
2010	698.516	2016	783.305
2011	759.599	2017	778.725
2012	779.071	2018	746.331
2013	755.876	2019	783.359
2014	765.367	2020	848.959
2015	769.604	2021	923.796

2.2 Disadvantages

(1) Uneven infrastructure development.

Although the growth rate of cold chain infrastructure in Liaoning Province has accelerated, it is still insufficient compared with the development needs. Cold chain facilities in rural and remote areas are lagging behind, affecting the quality control and logistics efficiency of fresh products and leading to rising supply chain costs.

(2) Inadequate technological innovation.

Liaoning Province has insufficient innovation in logistics management technology and supply chain informatization, and there is a significant gap compared with other regions in China. This leads to a lag in information flow, making it difficult to grasp market dynamics and inventory in real time.

(3) The overall management level of supply chain needs to be improved.

Although Liaoning Province recognizes the importance of green supply chain management for long-term development, there are still a variety of problems in actual operation. The poor management of multiple links leads to a relatively high loss rate of fresh products.

(4) Small enterprise scale and low industry concentration.

Enterprises in Liaoning province in the field of fresh produce supply chain are mostly small and medium-sized, with a low degree of clustering and branding. The scale effect is not obvious, and it is difficult for enterprises to achieve optimization in cost control and risk prevention.

(5) Low degree of standardization of logistics operations.

In the logistics operation of fresh products in Liaoning Province, there is still a lack of unified and standardized operational processes and norms. This situation leads to low operational efficiency in different links, which in turn affects the overall operation time and quality of fresh products.

2.3 Opportunities

(1) Policy and market demand are driven in both directions.

Policies such as the Implementation Program for High Quality Development of Cold Chain Logistics (2022-2025), which is being implemented in Liaoning Province, provide macro guidance and policy support for the development of fresh supply chain. It constitutes the top-level institutional design and policy support system for the optimization and upgrading of fresh food supply chain. The precise layout and macro guidance at the policy level come to shape an efficient, safe and green cold chain logistics service system, laying a solid foundation for the long-term development of fresh food supply chain.

At the national level, the distribution of cold chain facilities shows obvious geographical differences. As shown in Figure 1, according to the distribution map of CCRA version 2022, this data indicates that the cold chain facilities in East, North and Central China regions are relatively concentrated, and the cold chain transportation network and system are relatively sound, which not only points out the example that Liaoning Province can learn from, but also reveals the direction of development and opportunities.

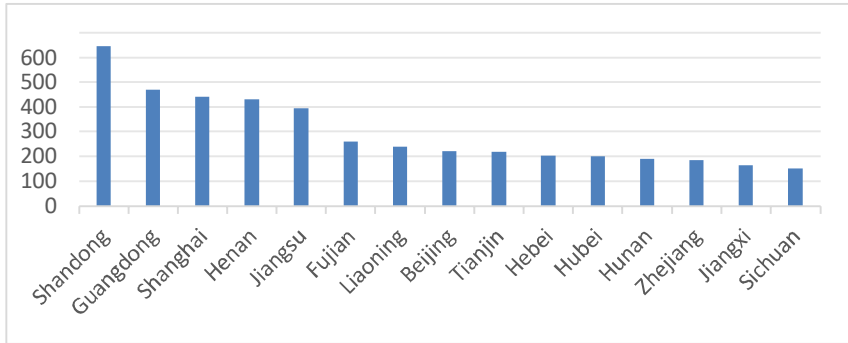


Fig. 1. Top 15 Regions of Cold Storage Capacity in China, 2022

(2) Internet of Things technology has a broad application prospect.

Intelligent management of cold chain logistics needs to rely on high technology, and the application of Internet of Things technology in fresh produce supply chain will be an important trend for future development as an important technical means to connect things.

(3) Supply chain finance innovation provides new financing channels.

As an innovative financial service model, supply chain finance, by virtue of the in-depth integration and optimized allocation of capital flow, logistics and information flow within the supply chain, improves capital operation efficiency and reduces operation cost by accurately matching the supply and demand of funds, thus driving the enhancement of the overall operation efficiency of the fresh produce supply chain.

(4) Cross-border e-commerce provides international market for fresh produce supply chain.

With the in-depth promotion of the "Belt and Road" initiative and the rapid development of the cross-border e-commerce industry, Liaoning Province, with its unique geographic location advantages and developed port facilities, has favorable conditions to develop the international market for fresh produce.

(5) New platform for fresh food supply chain management.

With their unique policy advantages, trade facilitation measures and efficient administrative service effectiveness, the new state-level zones and FTZs in Liaoning Province provide an excellent testing ground and display window for the exploration and practice of innovative modes of fresh food supply chain.

2.4 Threats

(1) Market price fluctuation risk.

Fresh products are highly time-sensitive, and any delays in the logistics process may lead to product losses and pose a threat to the fresh food industry.

(2) Food safety and quality control challenges.

Due to the perishable nature of fresh products, coupled with imperfect refrigeration facilities and lax control in the distribution chain, it is easy to harm the interests of

consumers, and also easy to damage the credit of enterprises and brands due to food safety accidents, affecting the stability of the entire supply chain.

(3) The speed of technological innovation and adaptability.

The rapid changes in technology, although the supply chain for fresh produce brings new opportunities, but also brings the pressure to adapt and follow up.

(4) The degree of matching supply and demand in the fresh food market is low.

Suppliers in the fresh food market tend to take production as their main consideration, which does not match with consumers' green consumption demand, resulting in less attention to the construction of green supply chain, which has caused some obstacles to the promotion of green supply chain.

3 GREEN SUPPLY CHAIN MANAGEMENT AND DEVELOPMENT STRATEGIES FOR FRESH PRODUCE IN LIAONING PROVINCE

(1) Strengthen infrastructure construction and standardized operation

Strengthen the layout and improvement of cold chain logistics infrastructure, especially the construction of cold chain facilities in rural and remote areas, so as to narrow the gap between urban and rural areas and meet the market demand for high-quality fresh products. At the same time, it is necessary to vigorously promote and implement uniform standards and specifications for cold chain logistics operations to ensure the standardization and normalization of the whole process of cold chain logistics and improve the overall efficiency and quality of cold chain logistics.

(2) Enhance scientific and technological innovation ability and strengthen informationization management

Strengthen investment in scientific and technological research and development, introduce and independently research and develop advanced cold chain logistics technology and intelligent equipment, and enhance the scientific and technological content and intelligent level of cold chain logistics. At the same time, improve the level of supply chain informationization management and make efforts to make up for the short boards in logistics management technology and supply chain informationization in Liaoning Province. Promote the establishment of a perfect cold chain logistics information system so that enterprises can adjust market strategies and optimize resource allocation in time.

(3) Integrate supply chain resources and optimize industry chain structure

Through policy guidance and market incentives, promote the integration and reorganization among enterprises in the supply chain of fresh produce in Liaoning Province, and enhance the concentration of the industry. Optimize the supply chain structure, shorten the flow of fresh products from the production end to the consumer end, reduce intermediate levels, improve logistics efficiency and reduce costs.

(4) Broaden financing channels and strengthen risk management

Fully utilize supply chain financial tools to provide flexible and fast financing solutions for the upstream and downstream enterprises in the supply chain of fresh produce, and enhance the liquidity and risk-resistant ability of the whole industrial chain.

Establish and improve the risk early warning and prevention and control mechanism to enhance the resilience and security of the supply chain through scientific risk assessment and management.

(5) Expanding with e-commerce and international market

Deepen the application of e-commerce in the supply chain of fresh produce, further expand the online market, and utilize e-commerce platforms, community group purchases, live streaming with goods and other modes of business to improve the market penetration and consumer convenience of fresh produce. Grasp the opportunities of the "Belt and Road" initiative and cross-border e-commerce development, and make use of Liaoning's geographic advantages and policy support to strengthen the international layout of fresh produce supply chain.

(6) Integration of green development and upgrading of consumer demand

Conform to the trend of green environmental protection, promote the greening and upgrading of the supply chain of fresh produce, encourage enterprises to adopt environmentally friendly production methods, promote green packaging, improve the efficiency of energy use, reduce carbon emissions, and enhance the environmental friendliness of the supply chain as a whole. Pay close attention to the upgrade of consumer demand for green, ecological and healthy food, and meet consumer demand for high-quality, safe and reliable fresh products.

Through a comprehensive SWOT analysis of the green supply chain of fresh produce in Liaoning Province, this paper not only reveals the strengths and challenges of green supply chain management in the region, but also proposes a series of innovative development strategies. These strategies not only provide practical guidance for the sustainable development of fresh produce supply chains in Liaoning Province, but also serve as references for other regions with similar geographic and economic conditions. In addition, this study emphasizes the importance of policy support, scientific and technological innovation, and infrastructure development in green supply chain management, providing new perspectives for future research and practice. We expect that future research will build on this study to further explore more dimensions and deeper issues of green supply chain management for fresh produce in Liaoning Province and nationwide.

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