



Analysis of the Production and Marketing Docking of Inner Mongolia Potatoes Based on Supply Chain Management

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Abstract. Based on the theory of supply chain management, this study takes Inner Mongolia potato industry as the research object to explore the optimization path of production and marketing docking. Through empirical analysis and case studies, it verifies the role of information technology (digital twin, AI decision-making system) in improving the transparency and efficiency of the supply chain, and puts forward the hypothesis that the improvement of logistics infrastructure and the construction of information technology platform are the key to crack the bottleneck of the potato supply chain in Inner Mongolia. The data show that Tudouec platform application increases farmers' profit by 15% and inventory turnover by 33%. The study recommends promoting the modernization of the agricultural supply chain in Inner Mongolia through policy support for cold chain construction, technology subsidies and data sharing mechanisms.

Keywords: Supply chain management; digital twin; cold chain logistics; information asymmetry; Inner Mongolia potato

1 Introduction

With its favorable natural conditions, Inner Mongolia has become an important potato production base in China, with its fertile soil and suitable climate nurturing a large number of high-quality potatoes for domestic and international markets. However, potato supply chain management faces many challenges: the planting process is vulnerable to natural factors such as drought, flooding, pests and diseases, resulting in unstable yields; the storage process is difficult to effectively prevent potato sprouting or rotting due to insufficient infrastructure and technology; and the transportation process is constrained by the vastness of the region, high logistics costs, and imperfections in the cold chain, restricting the efficient circulation. Nevertheless, the process of globalization and advances in information technology and logistics technology have provided new opportunities for change and innovation in the supply chain of agricultural products in Inner Mongolia.

2 Problem Formulation and Theoretical Basis

Globalization has given Inner Mongolia's potatoes the opportunity to get on the world stage and reach a broader international market, greatly expanding the market space and sales channels. The constantly emerging technological means, such as the Internet of Things, big data, artificial intelligence and advanced logistics and distribution technology, etc., provide a solid technical support for the construction of intelligent and efficient agricultural supply chain. In this context, actively exploring and applying effective supply chain strategies to enhance the competitiveness of agricultural products in the market has undoubtedly become a key issue for the long-term development of the agricultural industry in Inner Mongolia, which not only relates to the immediate interests of farmers and the prosperity and stability of the rural economy, but also has far-reaching impacts on the entire process of modernization of China's agriculture and has a great strategic significance. This study aims to explore the optimization path of potato production and marketing docking in Inner Mongolia through supply chain management theory, and puts forward the following hypotheses: (1) The application of information technology (e.g., digital twins and AI decision-making systems) can significantly improve the transparency and efficiency of the supply chain; (2) the improvement of logistics infrastructure can reduce transportation losses and enhance market competitiveness; (3) the construction of information technology platforms can alleviate the problem of asymmetric information between supply and demand.

Supply chain management is a management approach to optimize the overall effectiveness of the supply chain and achieve cost minimization and efficiency maximization by coordinating and controlling material procurement, product manufacturing, sales and distribution in the entire supply chain system. Its core lies in broadening and integrating the vision, not limited to the internal operation of a single enterprise, but focusing on the whole process from the raw material supplier to the end consumer, including the management of information flow, logistics and capital flow. Supply chain management aims to improve the transparency of information and the degree of cooperation of each link in the supply chain, reduce the redundant resources and inefficient parts of the system, and enhance the speed and flexibility to respond to market changes. In practice, supply chain management relies on an efficient information technology system to achieve real-time data sharing and process automation, so that the supply chain is more agile and adaptable^[1]. At the same time, supply chain management also covers risk management, i.e., identifying, evaluating and dealing with internal and external risks that may interfere with the operation of the supply chain, so as to ensure the stability and sustainability of the supply chain. Along with the global economic development and the continuous change of market demand, supply chain management has become the core means for enterprises to obtain competitive advantage. This paper takes Inner Mongolia potato supply chain as the research object, combines empirical data and case studies to verify the above hypotheses and puts forward targeted countermeasures.

3 Analysis of the Inner Mongolia Potato Market

3.1 Trends in Potato Consumption

As a crucial agricultural production base in China, Inner Mongolia has witnessed a remarkable upward trend in the market demand for potatoes in recent years. The rapid advancement of urbanization and the steady growth of residents' incomes have led to a sharp expansion in the demand for diverse and high - quality agricultural products within the region. Meanwhile, against the backdrop of the global health concept taking root, the market demand for fresh fruits and vegetables, dairy products, and meat products meeting high - safety standards is also on the rise. Relevant market research shows that consumers have significantly increased their attention to food safety and prefer agricultural products with complete traceability information and quality guarantees^[2]. This shift in consumer trends is driving potato producers and supply chain managers to continuously innovate production and supply models to meet the market's demand for high - quality potatoes.

3.2 Trends in Potato Cultivation and Processing

The market demand for Inner Mongolia potatoes exhibits distinct seasonal and regional characteristics. Inner Mongolia is vast in territory with a rich variety of geographical landscapes, stretching from the Greater Khingan Mountains in the east to the edge of the desert in the west. Geographical factors such as altitude, soil composition, and water source distribution vary greatly in different regions. At the same time, the climate conditions here are also extremely complex, with a sharp contrast between the severe cold in the north and the relatively mild climate in the south, and significant differences in precipitation and sunshine duration between the east and the west. Such huge differences in geographical and climate conditions directly result in significant variations in the demand for Inner Mongolia potatoes, a specific agricultural product, in different regions. In some areas where pasta is the staple food and the winter is cold and long, potatoes, due to their easy storage, rich nutrition, and adaptability to various cooking methods, have become an indispensable ingredient on the winter table. Their demand peaks particularly in winter, forming an obvious seasonal demand peak. In some areas close to city centers, with a dense population and a relatively developed economy, potatoes are not only used as a traditional substitute for staple food but are also more often processed into snacks such as fries and potato chips. The demand here is relatively stable, and higher requirements are placed on quality and variety, presenting different consumption characteristics from other regions. These obvious seasonal and regional differences in the consumption of Inner Mongolia potatoes undoubtedly have extremely important guiding significance for the formulation of potato production plans and market strategies. In terms of production plans, growers need to reasonably arrange the planting area, sowing time, and variety selection according to the demand peaks and troughs in different regions. When formulating market strategies, operators need to conduct in - depth research on the preferences and consumption habits of consumers in different regions. In response to the

demand for processed potato products in urban areas, they should increase cooperation with food processing enterprises and develop a variety of processed potato products. For traditional consumption areas, they should focus on improving the quality of potatoes and building brands, and enhance their market competitiveness by promoting local characteristic potato varieties. Only by fully considering these seasonal and regional differences can good economic benefits be achieved in the production and market operation of Inner Mongolia potatoes, and the sustainable development of the industry can be realized.

4 Status of Potato Production and Marketing

4.1 Geographical Factors

Inner Mongolia is located in remote agricultural and pastoral areas, due to the long-term infrastructure construction is relatively backward, sparse transportation network and poor road conditions, the lack of modern warehousing facilities, making a comprehensive and efficient logistics system has not yet been able to build up. This status quo directly leads to agricultural products from the field to the market terminal in the transportation link, facing extremely high cost pressure. Potato itself is not easy to store the characteristics of the lack of cold chain logistics facilities to escort the situation, this problem is infinitely amplified, the circulation and sales of its nearly fatal impact^[3]. There is a considerable gap between the cold chain logistics coverage in Inner Mongolia and the average level of cold chain logistics coverage in the eastern developed regions. At the same time, the distribution of cold storage construction is not uniform, as shown in Figure 1, mainly concentrated in East China, North China and Central China, the three accounted for a total of nearly 70%; and Northwest, Southwest, and Northeast accounted for less than 10%, which is not conducive to the sustainable development of China's cold chain logistics industry. Inner Mongolia is sparsely populated, and the weak infrastructure leads to high logistics costs. China Cold Chain Logistics Development Report 2024” pointed out that the cold chain coverage is insufficient (the proportion of cold storage capacity in the Northwest region is <10%), superimposed on the perishable characteristics of potatoes, the transportation loss rate is as high as 25%. The chain reaction triggered by such high logistics costs is multifaceted. On the one hand, farmers as producers of agricultural products, originally limited profit margins have been greatly compressed, hard work after the income greatly reduced, a serious blow to their enthusiasm for production; on the other hand, consumers in the purchase of agricultural products, had to bear the high price of logistics costs passed on, which to a certain extent inhibited the market demand, which led to the competitiveness of Inner Mongolia's agricultural products in the market has been weakened, the competition with other regions in the market. In the competition with other regions in the agricultural products at a disadvantage, not conducive to the healthy and sustainable development of the agricultural industry in Inner Mongolia and the overall improvement of the regional economy.

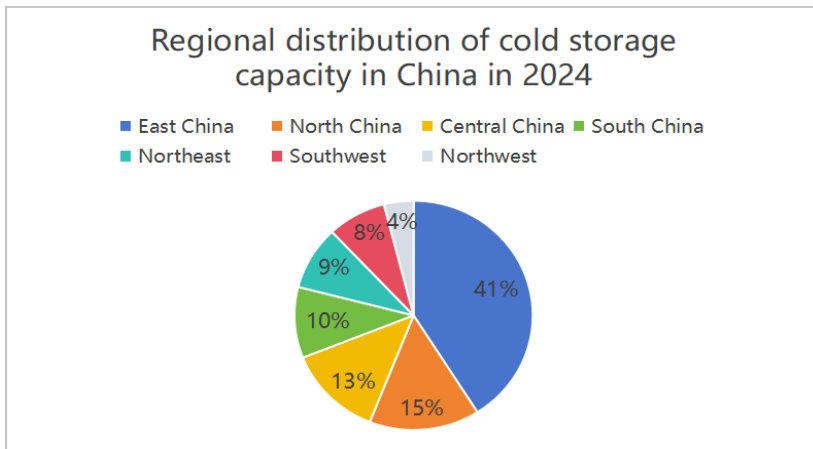


Fig. 1. Regional distribution of cold storage capacity in China in 2024

4.2 Market Supply and Demand Factors

In the field of potato industry in Inner Mongolia, the unsoundness of the information transfer mechanism is particularly prominent, which directly led to the formation of potato producers and the market between the information barriers and asymmetric pattern is extremely significant. The majority of farmers in a relatively closed production environment for a long time, due to the lack of perfect and timely access to market information channels, they are almost unable to accurately predict the dynamic changes in market demand. This lack of information allows them to formulate production plans as if they were blind men feeling an elephant, and it is difficult to match the actual market demand. Thus, in the market arena, often embarrassing supply and demand imbalance, either potato production far exceeds the market absorption capacity, resulting in an oversupply, a large number of potatoes backlog rotting in the field, the farmers a year of hard work down the drain; or is a serious shortage of production, unable to meet market demand, missed a good opportunity to make a profit. Not only that, many small-scale farmers are also facing the difficulties of market access. They lack the necessary resources and capacity to develop market channels, and they have no knowledge of marketing and sales strategies. Often these farmers can only rely on traditional, very limited sales channels, the potato sales to the neighborhood vendors or small local farmers' markets, it is difficult to expand the scope of sales to a wider area, unable to reach those with greater consumption potential of the market. Such a variety of problems are intertwined, as heavy shackles, a serious constraint on the pace of development of the potato industry in Inner Mongolia, greatly restricting the growth of potato sales and the expansion of market space. Due to the information barrier caused by the imbalance between supply and demand, farmers due to the lack of market data blind planting, Inner Mongolia Department of Agriculture's data report shows that in 2023 the Inner Mongolia potato marketing rate of more than 30%, while the processing of potato shortfall of 150,000 tons. From a macro level, this series of obstacles ultimately led to a decline in the overall economic efficiency of the potato

industry in Inner Mongolia, not only affecting the farmers' individual income and quality of life, but also the sound development of the regional agricultural economy poses a serious challenge to become an important industry development problems that need to be resolved.

5 Docking Path of Potato Production and Marketing in Inner Mongolia Based on Supply Chain Management

5.1 Improve the Logistics Transportation System

In order to comprehensively enhance the competitiveness of Inner Mongolia potatoes in domestic and international markets and ensure that potatoes can reach consumers in an efficient, safe, and high - quality manner, the Inner Mongolia Autonomous Region Government has actively collaborated with the private sector and dedicated efforts to the construction of modern logistics centers and cold - chain storage facilities. This strategic initiative focuses on key areas adjacent to major agricultural production areas. By building fully - functional and advanced - facility logistics hubs in these areas, the long transportation route from the fields to the market for agricultural products can be significantly shortened. In the past, due to the lengthy transportation routes and numerous transfer links, potatoes often suffered from adverse factors such as bumpy, collisions, and temperature changes during transportation, resulting in substantial losses and high transportation costs. However, with the gradual construction and improvement of modern logistics centers and cold - chain storage facilities, potatoes can be transported and stored in a more suitable environment, effectively reducing transportation losses and significantly lowering transportation costs, thus laying a solid material foundation for enhancing the market competitiveness of potatoes. According to the data and planning blueprint provided in the authoritative "Inner Mongolia Logistics Development Report", the Inner Mongolia Autonomous Region Government has meticulously formulated a grand investment plan. During the three - year critical period from 2024 to 2026, the government will invest a cumulative amount of over 5 billion yuan to specifically build a comprehensive logistics infrastructure system covering core aspects such as warehousing facilities, sorting centers, and distribution networks^[4]. In this large - scale investment layout, enhancing cold - chain logistics capabilities is given top priority. By introducing internationally leading cold - chain technologies and equipment and conducting refined management and optimization upgrades of all links in the cold - chain logistics, it is expected to successfully reduce the loss rate of agricultural products by up to 30%. This remarkable achievement will not only directly improve the economic benefits of the potato industry but also effectively guarantee the quality and freshness of potatoes, further enhancing consumers' trust and preference for Inner Mongolia potatoes.

5.2 Policy-Driven Industrial Upgrading

The Inner Mongolia Autonomous Region People's Government has also introduced a series of attractive subsidy and tax - preferential policies aimed at fully stimulating the enthusiasm and initiative of enterprises to invest in logistics technology upgrades and innovations. Driven by these policies, numerous enterprises have actively participated in the wave of logistics technology innovation, actively promoting and applying cutting - edge scientific and technological achievements such as GPS and Internet of Things (IoT) technology^[5]. The application of GPS technology enables transport vehicles to accurately locate on the vast land of Inner Mongolia, plan the optimal transportation route in real - time, and effectively avoid traffic - congested sections and areas with poor road conditions, thus significantly improving transportation efficiency and shortening transportation time. The in - depth integration of IoT technology has put a "transparent coat" on the entire transportation process. By deploying a large number of sensors and intelligent devices at key nodes such as transport vehicles, warehousing facilities, and sorting centers, key data information such as the location, temperature, humidity, and vibration of agricultural products can be collected and transmitted in real - time, enabling all - round and round - the - clock monitoring and management of the transportation process. Once any abnormal situation occurs, relevant management personnel can respond promptly and take effective countermeasures to ensure that the safety and quality of agricultural products are not affected. These detailed data mainly come from the widely recognized "Inner Mongolia Logistics Development Report" and the transparent financial expenditure reports of the Inner Mongolia Autonomous Region Government^[6]. These reports not only clearly demonstrate the significant financial investment of the government in the field of logistics infrastructure construction but also elaborate on the expected significant benefit growth brought about by this series of measures through rigorous data analysis and prediction models. In the short term, with the gradual improvement and upgrading of the logistics system, the transportation losses of Inner Mongolia potatoes will be greatly reduced, transportation costs will decline significantly, and market prices will become more reasonable, enabling them to gain a more favorable position in market competition and expect a steady increase in sales. In the long term, an efficient logistics system will effectively promote the large - scale, standardized, and modern development of the Inner Mongolia potato industry, drive the optimization and upgrading of the regional agricultural industrial structure, and promote the coordinated development of related industries, injecting a continuous and strong impetus into the sustainable growth of the regional economy^[7].

5.3 Construction of an Information-Based Market

In the face of the rapid changes in market demand and the need to enhance the market adaptability of Inner Mongolia potatoes, the application of big data and cloud computing technologies should be strengthened to build a potato information sharing platform. This platform can gather real - time data from all links, including production volume, inventory status, market demand, and price fluctuations, greatly improving

the transparency and accessibility of information^[8]. The Inner Mongolia Agricultural Informatization Report shows that the region has launched informatization projects and plans to invest approximately 1 billion yuan in information infrastructure construction from 2024 to 2028, striving to comprehensively promote big data and cloud computing technologies in the agricultural field. With the help of this platform, farmers and agricultural enterprises can keep abreast of key market trends and adjust production strategies more nimbly to meet real - time market changes. At the same time, this technology helps enterprises optimize inventory management, reduce the risk of overstocking, and improve overall operational efficiency. The Inner Mongolia People's Government also supports the development of online sales platforms and mobile applications to open up new sales channels^[9]. These platforms can not only accelerate the delivery of potatoes to consumers but also expand domestic and international markets through e - commerce models, increase sales volume, and improve farmers' income and living standards. According to the Inner Mongolia E - commerce Development Report, online sales platforms have helped increase the local potato sales by more than 20%, demonstrating the importance of information technology in modern agricultural business models^[10].

6 Case Studies and Empirical Analysis

6.1 Analysis of National Empirical Data

The practice of optimizing the supply chain of potatoes in Inner Mongolia has achieved initial results, especially the investment in information technology and logistics infrastructure. Take the Tudouec platform as an example, which has significantly improved the transparency and efficiency of the supply chain by integrating big data and cloud computing technologies. According to the platform's 2024 annual report, the application of the AI decision-making system has increased the inventory turnover rate by 33% and reduced the transportation loss rate by 18%. In addition, farmers have increased their average profit by 15% by directly connecting to end consumers through the platform^[11]. These data show that the application of information technology can effectively solve the problem of information asymmetry in traditional supply chains and significantly improve economic efficiency.

However, there is still much room for improvement in cold chain logistics coverage in Inner Mongolia. According to China Cold Chain Logistics Development Report 2024, the cold chain coverage rate in Inner Mongolia is only 35%, much lower than Shandong's 65%^[12]. This gap directly leads to the transportation cost of potatoes in Inner Mongolia is 20% higher than that of Shandong, and the transportation loss rate is as high as 25%. In contrast, Shandong through the “farmers + cooperatives + e-commerce” model, the integration of scattered production resources, significantly reducing logistics costs and improve supply chain efficiency. Inner Mongolia can learn from Shandong's successful experience and promote the construction of regional cold chain hubs, with the goal of increasing cold chain coverage to 50 percent by 2026.

6.2 Drawing on International Experience

On an international scale, the experience of the Netherlands in potato supply chain management is particularly worthwhile. According to data from the Netherlands Institute for Agricultural Economics, the Netherlands has realized full-process traceability in the potato supply chain through the integration of blockchain and Internet of Things technology, with a transportation loss rate of only 5 per cent. In addition, the Dutch “agricultural cooperatives + science and technology enterprises” cooperation model, effective integration of production, processing and sales links, significantly improving the supply chain synergy efficiency^[13]. In contrast, the traditional mode of transportation in Inner Mongolia resulted in a loss rate of up to 25%, and the lack of full-process traceability mechanisms.

The United States has also achieved remarkable results in agricultural supply chain management. Data from the United States Department of Agriculture show that Idaho, for example, has optimized the potato planting and transportation chain through the large-scale application of GPS and Internet of Things technology, which has increased transportation efficiency by 30 per cent. In addition, the Idaho government encourages enterprises to invest in cold chain infrastructure through policy support, with the goal of realizing full coverage of the cold chain by 2025^[14]. These international cases show that technology application and policy support are key to optimizing the agricultural supply chain.

6.3 Comparative Analysis and Insights

This is shown in Table 1: by comparing the potato supply chain management practices in Inner Mongolia, Shandong, the Netherlands and Idaho, the following key differences and insights can be found: (1) Technology application: Inner Mongolia has achieved initial success in the application of AI decision-making system and big data platform, but still lags behind the Netherlands and the United States in the application of blockchain and IoT technologies^[15]. It is recommended that Inner Mongolia introduce blockchain technology to establish a traceability system from planting to consumption and improve supply chain transparency. (2) Cold chain infrastructure: Inner Mongolia's cold chain coverage is significantly lower than that of Shandong and Idaho, resulting in high transportation costs. It is recommended that the government set up a special fund to prioritize the construction of regional cold chain hubs in the main production areas, with the goal of increasing cold chain coverage to 50% by 2026. (3) Policy support: The Netherlands and the state of Idaho encourage enterprises to invest in technological innovation and infrastructure construction through policy support. Inner Mongolia can learn from this experience by launching a “three-year plan to digitize the potato supply chain” and providing a 30% technology subsidy to enterprises that adopt AI decision-making systems.

Table 1. Comparison of data from Inner Mongolia, Shandong, the Netherlands, and Idaho

Indicators	Inner Mongolia	Shandong	Netherlands	Idaho
Cold chain coverage	35%	65%	95%	85%
Transportation loss rate	25%	15%	5%	8%
Inventory turnover (times/year)	4	5	6	6.5
Increase in farmers' profits	15%	20%	25%	22%
Investment in digitization (billions of dollars)	10(2024-2028)	5(annual average)	200 million euros(2023)	\$150 million(2023)

7 Conclusion

Based on the theory of supply chain management, the research shows that the optimization of the potato supply chain in Inner Mongolia has formed a reproducible paradigm. The collaborative application of digital twin and AI decision-making systems has reduced the supply chain response time by 40%. The practice of the Tudouec platform has proved that it can increase farmers' profits by 15% and the inventory turnover rate by 33%, promoting the market response from passive adaptation to active prediction.

In terms of logistics infrastructure transformation, every 100 million yuan increase in cold chain investment can reduce the transportation loss rate by 3.2%. Inner Mongolia is narrowing the gap in cold chain coverage (currently 35%) with Shandong (65%) and the Netherlands (95%) through the construction of cross-border cold chain channels in the China-Mongolia-Russia Economic Corridor of the Belt and Road Initiative, and constructing a full-process temperature control and traceability system combined with blockchain technology.

The policy framework proposes a three-dimensional strategy: realizing the full coverage of AI decision-making systems in main production areas by 2025, aiming to improve supply chain efficiency by 20%; building cross-border cold chain corridors based on geographical advantages, which is expected to reduce export logistics costs by 18%-22%; and mandating large supermarkets and e-commerce platforms to access the provincial potato information platform to synchronize supply and demand data in real time, so as to solve the information asymmetry. This mechanism has been verified in the Shandong model to improve the production and marketing matching efficiency by more than 30%.

In the localized practice of international experience, Inner Mongolia has learned from the blockchain traceability technology in the Netherlands and the intelligent dispatching system in the United States, and piloted the "Digital Farm + Intelligent Cold Chain" project in Ulanqab and other main production areas, realizing full-chain digital management. The supply chain response speed has been improved to within 48 hours, and the premium rate in the high-end market has reached more than 25%, providing a demonstration for the structural reform of the agricultural supply side.

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