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Green Transformation in Agricultural Supply Chains: A Case Study of Jinhuai Q Enterprises' Transition Towards Carbon Neutrality

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Abstract: This paper examines the current state of supply chain operations at jinhuaii Q Enterprises, a leading company in the jinhuaii industry, and explores its transition towards a green, carbon-neutral supply chain. Given the growing importance of addressing climate change and the need for sustainable agricultural practices, this study investigates how jinhuaii Q Enterprises is adapting to the challenges of integrating green logistics and carbon neutrality in its supply chain. By conducting a detailed survey of the company's upstream, midstream, and downstream supply chain segments, we identify critical issues such as fragmented planting distribution, low mechanization in processing, and the need for better sustainability in downstream sales channels. Furthermore, we propose strategic recommendations to enhance supply chain management, including the implementation of a carbon-neutral supply chain, improvements in deep processing technology, and optimizing collaboration across different sectors. This study provides valuable insights for both jinhuaii Q Enterprises and other agricultural businesses aiming to achieve sustainable growth and contribute to national carbon neutrality goals.

Keywords: Agricultural Supply Chain; Green Transformation; Agricultural Logistics; Sustainability; Supply Chain Optimization

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1.Introduction

With the escalating severity of global climate change and environmental challenges, the green transformation and sustainable development of the agricultural industry have become urgent global priorities (Zhu et al., 2023). In China, the introduction of the "dual carbon goals" policy has made it imperative to focus on achieving carbon neutrality across various sectors, including agricultural supply chains (Zhuang & Wang, 2023). As a key component of agricultural supply chains, agricultural logistics plays a critical role in the efficient allocation and circulation of resources (He et al., 2023). Its importance is growing, particularly in driving the green transformation of agriculture and achieving carbon neutrality targets (Qi et al., 2023).

In the context of specialized sectors like the Jinhuai industry, agricultural logistics management faces numerous challenges, including upstream and downstream supply chain coordination, product quality control, and green development (Shao & Hu, 2021; Li & Ouyang, 2024). Specifically, Jinhuai Q Enterprises, as a leading representative in China's Jinhuai industry, has established a relatively complete industrial chain across upstream planting, processing, and downstream consumption (Zhang, 2024). However, the company faces several challenges in its development. For example, the distribution of Jinhuai planting is fragmented, mechanical processing technology is underdeveloped, and the sustainability of its supply chain is lacking (Ni et

al., 2024). These issues significantly impact the company's competitiveness in both domestic and international markets (Jiang, 2024). The root causes of these problems are often closely tied to the traditional agricultural supply chain management model, especially in areas such as the digitalization of agricultural logistics, supply chain coordination, and technological innovation (Wang et al., 2024; Li, 2024).

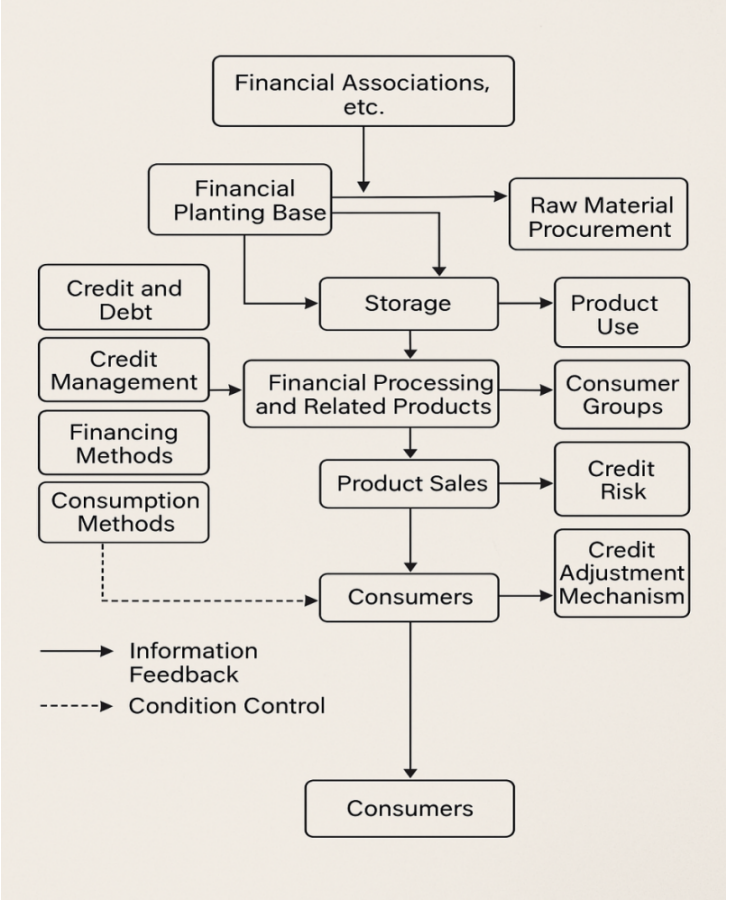
Therefore, this paper aims to provide an in-depth analysis of the operational status of Jinhuai Q Enterprises' supply chain, exploring pathways for promoting green logistics, carbon-neutral supply chains, and product quality improvements (Guo & Yao, 2023). By conducting a detailed survey of the Jinhuai industry supply chain, the paper proposes strategies to strengthen supply chain management, enhance deep processing capabilities, and optimize collaboration across supply chain segments (Zhang & Wen, 2023). Furthermore, through the integration of digital transformation and strategic alignment with carbon neutrality goals, this paper offers practical solutions that not only have significant implications for Jinhuai Q Enterprises' sustainable development but also provide valuable insights and recommendations for the green transformation of other agricultural enterprises' supply chains (Zhao, 2012; Jiang, 2024).

2.Research on the current status of enterprise supply chain

2.1 Survey of Supply Chain Operations of Jinhuai Q Enterprises

Based on a comprehensive survey of Jinhuai Q Enterprises, the current operational status of the company's supply chain has been assessed. The company's goal is to create new markets, new formats, and new energy sources. In the upstream segment of the supply chain, most of the production is managed internally by the company. Currently, the company benefits from a relatively abundant supply of raw materials, with six "Jinhuai" planting demonstration bases and 40,000 acres of high-quality "Jinhuai" cultivation land. With an estimated yield of approximately 157 kg per acre, the annual production of locust seed is about 6,280 tons. This has facilitated the development of a relatively complete product system downstream, including products such as pharmaceuticals, tea, traditional Chinese medicine, health supplements, and cosmetics, all of which are directed at consumers.

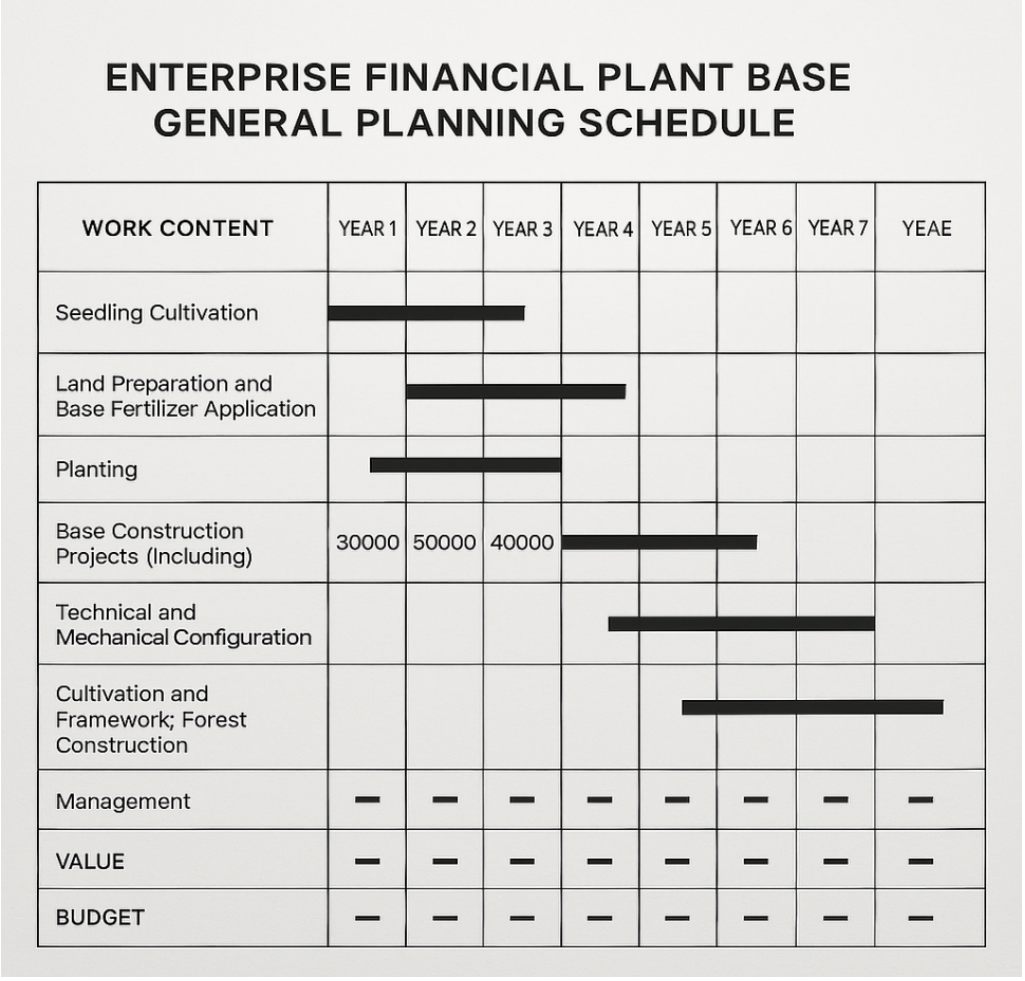
Fig. 1. Supply Chain Operation Diagram of Jinhuai Q Enterprises



(1) Upstream Supply Chain: Jinhuai Planting

According to the "Jinhuai Planting Base Construction Master Plan," Jinhuai Q Company has established six "Jinhuai" planting demonstration bases. Additionally, three towns have developed approximately 40,000 acres of high-quality locust seed production bases, yielding around 6,280 tons of locust seed annually. The average yield can reach up to 157 kg per acre, indicating a relatively stable and sufficient supply of locust raw materials.

Fig. 2. Progress Arrangement of the Overall Planning for the Construction of Acacia Planting Bases of Jinhuai Q Enterprises



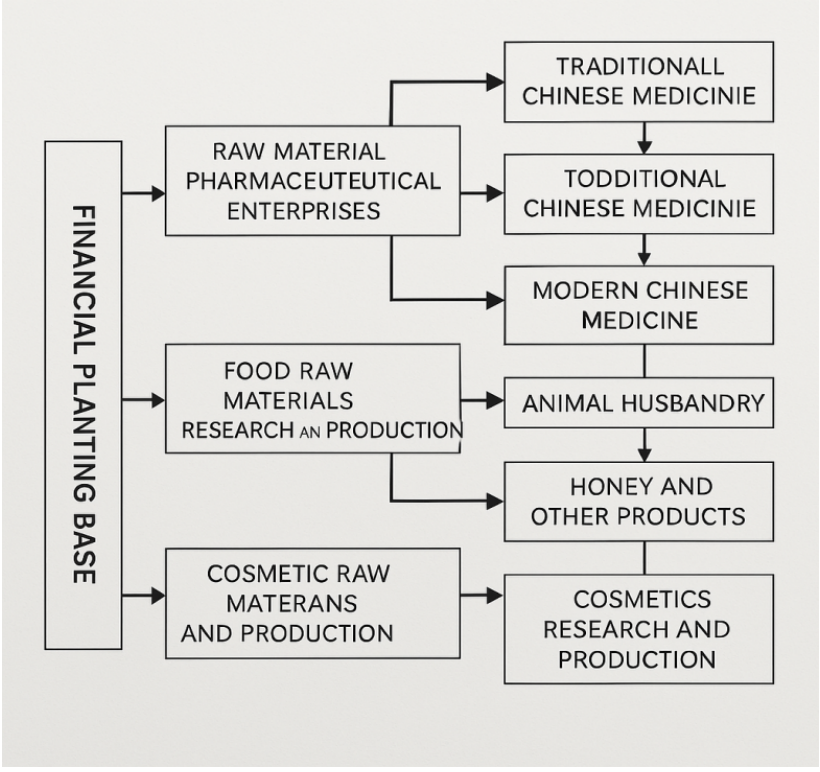
(2) Midstream Supply Chain: Jinhuai Processing

According to the survey, the company has multiple industrial chains for the deep processing of Jinhuai locust (as shown in Fig. 3) and has mastered advanced techniques for the deep processing of locust seeds. With an annual production of 6,280 tons, it is projected that the value of the deep-processed locust seeds will reach approximately 37.68 million RMB annually. Currently, Jinhuai Q Enterprises operates several deep-processing industry chains and has mastered a range of advanced processing techniques, including rutin extraction and locust seed processing.

One of its core technologies—the molecular transformation method for producing high-purity rutin—is a domestic first and has been awarded a national invention patent. This method leverages the molecular characteristics of flavonoid glycosides, which consist of 2-phenylchromone with a planar structure, small intermolecular spacing, and strong attractive forces. The application of molecular transformation enables the production of rutin with a purity exceeding 99%, fully meeting the requirements for export. Compared to traditional methods, this technique improves the yield by 10%.

All products manufactured by the company conform to the German Pharmacopoeia, currently considered one of the most rigorous pharmaceutical references globally. In terms of quality, these products surpass those of similar Japanese imports and offer a significant cost-performance advantage. Consequently, Jinhuai Q Enterprises has broken China's historical reliance on imported rutin and disrupted Japan's dominance in refined rutin products.

Fig. 3. Deep Processing Industry Chain of Jinhuai Q Enterprises



(3) Downstream Supply Chain: Jinhuai Consumption

At present, the downstream segment of Jinhuai Q Enterprises has developed into a relatively complete industrial chain. The extracted rutin is used in pharmaceutical development and production and is further processed into tea, traditional Chinese medicine, and health products. Additionally, processed locust seeds are used for the development of functional foods and beverages, while refined rutin serves as a key ingredient in the production and R&D of cosmetics.

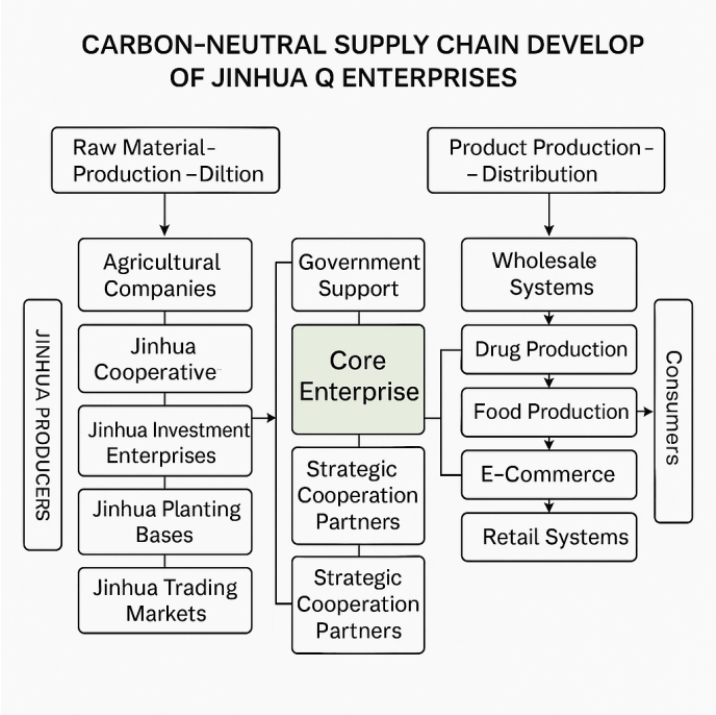
The company has developed more than 20 types of Jinhuai-based products, which have significantly stimulated the growth of the broader Jinhuai industry in the region, forming a solid foundation for integrated industrial development.

2.2 Carbon-Neutral Supply Chain Development of Jinhuai Q Enterprises

Global climate change is one of the major issues humanity faces in the 21st century. Its impact not only affects the living environment of humans but also has significant consequences on the global economy and geopolitics. In 2023, global carbon dioxide emissions from energy production reached 3.74 billion tons, setting a historical record. With the worsening climate and environmental challenges, there is an urgent need to implement proactive measures to achieve “net-zero emissions.” On September 22, 2020, President Xi Jinping presented China’s “dual carbon goals” for 2030 and 2060 at the 75th United Nations General Assembly, marking a major step toward global efforts to address climate change and accelerating the pace of global emission reduction.

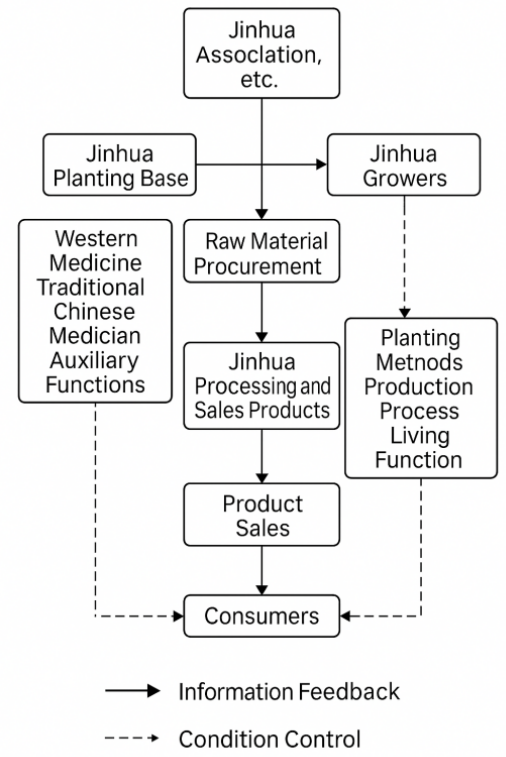
In the process of formulating the “carbon-neutral” strategy, reinforcing the green and carbon-neutral supply chains of enterprises is a critical component. Currently, Jinhuai Q Enterprises is progressing towards the development of a “carbon-neutral supply chain.” The aim is to establish a unique carbon sink economic model, promote industrial transformation towards low-carbon, green, and environmentally-friendly practices, and adapt to the trends of “low-carbon” and “zero-carbon” development. By focusing on “soft technologies” such as locust tree planting, energy conservation, emission reduction, and strengthening the carbon-neutral supply chain system, Jinhuai Q Enterprises is responding to the demands of the current era, seizing opportunities, and contributing to the realization of the “dual carbon goals.” The company is establishing a comprehensive carbon-neutral supply chain system, making significant contributions to China’s sustainable development and the construction of a global community with a shared future for humanity.

Fig. 4. Schematic Diagram of the Development of the Carbon-Neutral Supply Chain of Jinhuai Q Enterprises



The construction of a carbon-neutral supply chain requires smooth material and information flows, supported by robust infrastructure and modern logistics systems. It represents a more efficient, agile supply chain that can quickly respond to market and user demand changes within a dynamic market environment, involving multiple suppliers and customers. Through scientific management practices, the carbon-neutral supply chain requires high quality in every stage of the manufacturing process, establishing strong cooperative relationships with suppliers, and accurately forecasting the needs of end-users to achieve Just-In-Time (JIT) production. Compared to traditional production and material management, this system enhances operational efficiency, streamlines business practices, and results in substantial cost savings for the company.

Fig. 5. Schematic Diagram of the Supply Chain Development Model of Jinhuai Q Enterprises

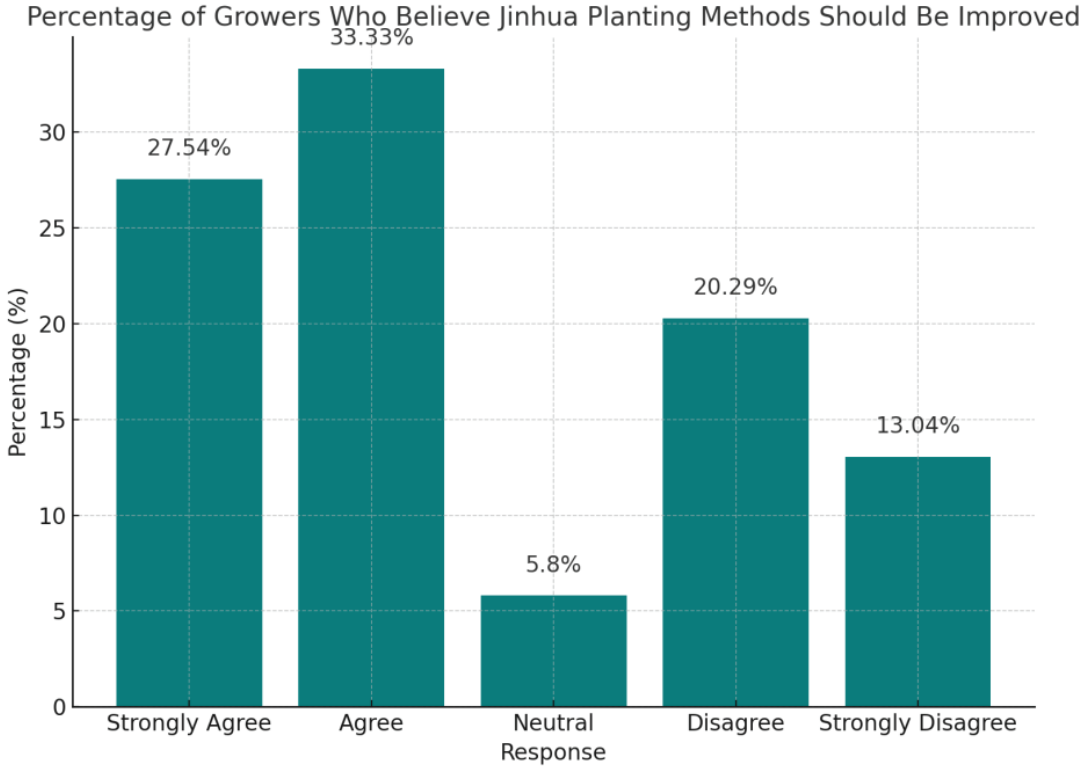


3.Issues in Jinhuai Q Enterprises' Supply Chain

3.1 Upstream Supply Chain – Characteristics of Small, Scattered, and Disorganized Planting Distribution

The planting distribution of Jinhuai is characterized by being "small," "scattered," and "disorganized," leading to significant market influence on small-scale farmers and instability in supply. We distributed questionnaires to growers, processing enterprises, consumers, and product sales consumers. By combining the survey results with the characteristics of Jinhuai planting distribution, we concluded that the "Jinhuai growers" in the supply chain need to accelerate the transition to large-scale and intensive planting methods. More than 60% of the growers believe that there should be a shift towards large-scale and intensive cultivation. Currently, scattered planting operations are highly susceptible to market fluctuations, resulting in instability in supply.

Fig. 6. Percentage of Growers Who Think that Jinhuai Planting Should Be Improved in Terms of Planting Methods



3.2 Midstream Supply Chain – Low Technological Content in Jinhuai Processing Equipment

Jinhuai Q Enterprises possesses a full range of tea processing equipment (such as rolling machines, dryers, screening machines, and air classifiers), but most of these are single-machine operations requiring manual supervision. The level of electromechanical integration is low, leading to inefficient production processes. While some automation has been introduced in the initial processing stages, many processes, especially drying and grinding in the pulp production process, are still manually operated. As a result, the overall mechanization of Jinhuai's initial processing is low. This slow pace of mechanization in initial processing has hindered the company's development.

3.3 Downstream Supply Chain – Weak Sustainability, Limited Sales Channels, and Insufficient Promotion Efforts

Currently, Jinhuai Q Enterprises has established both online and offline sales channels for its Jinhuai tea, but both remain at a small scale. The offline stores are limited to the county, which hinders consumer awareness and product experience. Our in-depth interviews with company leaders revealed that the downstream supply chain lacks sustainability, with limited sales channels and insufficient promotional efforts. Despite previous attempts to expand sales to other regions and through micro-commerce, results were underwhelming. For example, online marketing efforts through WeChat were discontinued due to low effectiveness, and the company also struggled with low profit margins when attempting to cooperate with tourism companies and restaurants.

4.In-depth micro-analysis of Samuel Kim Q Enterprises

4.1 Micro Analysis 1----Inadequate Training for Supply Chain Management Personnel at Jinhuai Q Enterprises

Table 1 Changes in purchasing staff at Gold Samuel Q.

Date	2019	2020	2021	2022	2023
Number of purchases	8	10	12	10	10
Number of new entrants	4	3	4	2	2
Number of withdrawals	2	1	6	2	3

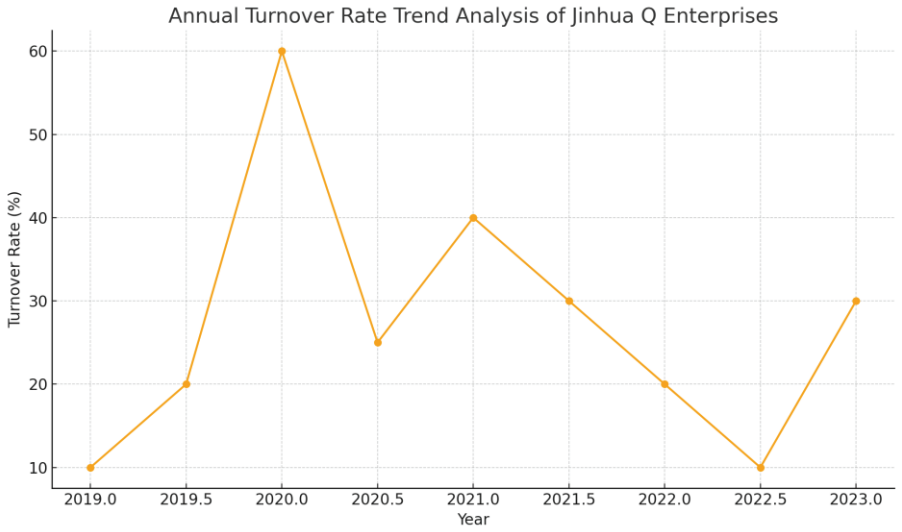


Fig. 7 Trend analysis of annual turnover rate changes in Samuel Gold Q enterprises

Year	Project	1st quarter	2nd quarter	3rd quarter	4th quarter
2022	Inventory amount	20	21	22.7	19.2
2023	Inventory Amount	18.2	19.4	20	17.3
2022	Inventory Turnover Days	42.2	50	48.3	47
2023	Inventory Turnover Days	47	45.9	44.2	49.2

As shown in Table 1 and Fig. 7, the personnel changes in the purchasing department of Jinhuai Q Enterprises are significant. The rapid expansion of the company's business has led to an increasing demand for purchasing talent. New employees, lacking systematic training, are often pressured to handle responsibilities without adequate preparation, which causes many to leave the company, particularly when they cannot cope with the fast-paced development of the company. In many cases, these new recruits leave within a year. In 2021, the turnover rate reached 60%, which is notably higher than the normal range of 10-15%. This situation is indicative of management issues within the company, leading to low job satisfaction among purchasing staff. Furthermore, the cost of turnover is low, and employees tend to leave Jinhuai Q Enterprises more quickly compared to other companies. The impact of the COVID-19 pandemic also contributed to this situation.

4.2 Micro Analysis 2----Inventory Issues at Jinhuai Q Enterprises

Table 2 Company's inventory amount and inventory turnover days

Unit: Millions of RMB

Based on a review of relevant data from the Chinese MBA business management database, inventory management in procurement can be classified as successful or unsuccessful in three main aspects:

1.Inventory Value = Inventory Volume × Unit Price

2.Raw Material Turnover Days = [(Current raw material inventory – Previous period's inventory) / Current total raw material inventory] × 30 days

3.Excess Inventory = Quantity of inventory that has not been used for over 60 days × Unit Price of raw material

After reviewing the 2023 Chinese Enterprise Accounting Standards and related accounting subjects, it was found that Jinhuai Q Enterprises has a higher inventory amount compared to its industry peers. Typically, the inventory value for similar companies is around 10 million RMB, with a turnover rate of around 30 days. In contrast, Jinhuai Q's inventory amount ranges between 180,000 and 220,000 RMB, with turnover days ranging from 42 to 50 days. This indicates that Jinhuai Q Enterprises is experiencing significant inventory management issues.

I have identified several issues with Jinhuai Q Enterprises' inventory management. The company faces problems such as high inventory volume and long inventory turnover cycles. These issues lead to a series of challenges, primarily including: large land area usage, impact on cash flow, and increased handling costs. The main reasons for Jinhuai Q Enterprises' large inventory volume include:The reasons for Jinhuai Q's large inventory and extended turnover period are as follows:

(1) Lack of Procurement Strategy in SCM: Purchases are made based on production volume, and inventory is replenished periodically until exceeding critical thresholds.

(2) Imbalance in Supply and Demand: The company's procurement strategy is rigid, and there is no market research conducted to analyze product sales, resulting in inaccurate forecasts of market demand.

(3) Absence of Effective Inventory Strategy and Management: The purchasing department has not categorized products and materials, leading to unorganized inventory management.

4.3 Micro Analysis 3 – Supplier Management Issues at Jinhuai Q Enterprises

(1) Lack of a Rational Supplier Evaluation System

Jinhuai Q Enterprises holds the purchasing rights for suppliers but tends to prioritize cost control, with the primary consideration being the unit price of suppliers. As a result, the company may cooperate with suppliers offering low prices but unable to ensure high-quality products. This can lead to significant losses for the company, highlighting the scientific shortcomings in Jinhuai Q's supplier selection process.

(2) Lack of Strategic Cooperation with Key Suppliers

Currently, the relationship between Jinhuai Q and most suppliers is transactional, and cooperation with large agricultural production bases is limited. The company has not yet developed long-term strategic cooperation with suppliers, which hinders the establishment of a stable and mutually beneficial partnership. Procurement is a vital part of the overall supply chain, and the management of suppliers should shift from being solely based on negotiations to strategic cooperation.

(3) Limited Information Sharing

Jinhuai Q Enterprises does not provide transparent announcements regarding the procurement of key agricultural products on its website. Occasionally, procurement plans are made casually in an effort to save costs, leading to short-term product shortages, especially for key raw materials. This has resulted in financial losses and frustration within the company, damaging mutual trust and preventing long-term cooperation.

(4) Excessive Number of Suppliers

To reduce costs, Jinhuai Q Enterprises tends to partner with multiple suppliers, which can lead to significant losses if a supplier fails to deliver sufficient raw materials due to factors like delayed payments or natural disasters. It is recommended that the company select only two or three strategic suppliers based on its specific needs.

5.Countermeasures and Suggestions for Supply Chain Optimization

5.1 Evolutionary Game Analysis of Growers, Purchasers, and Jinhuai Association

(1) Government Promotion Through Policy: The government can use policies to promote long-term cooperation between Jinhuai-related enterprises and factor institutions, extending the industrial chain and weaving a complete supply chain. After reaching a certain scale, these industrial chains should be evaluated by professionals to identify key nodes, which can be developed into an "industrial tree," creating a distinctive and scaled industry.

(2) Establishment of Jinhuai Industrial Union: By mutual shareholding, signing long-term cooperation agreements, and establishing non-profit coordinating bodies, Jinhuai enterprises can expand their business scope and create value collectively.

(3) Creation of Innovative Jinhuai Industrial Organizations: Industrial innovation clusters gather talent, knowledge, and technology along the same value chain. Establishing a Jinhuai industrial innovation alliance

5.2 Supply Chain Management Personnel

(1) Management Personnel

Jinhuai Q Enterprises should provide more opportunities for supply chain management personnel to enhance their training and knowledge, including attending academic courses at agricultural universities like Zhongkai University of Agricultural Engineering and engaging in online learning about supply chain management.

(2) Establishing Mechanisms

Implementing a reasonable system of rewards and penalties can effectively motivate employees and reduce incidents in the procurement process, ultimately lowering procurement costs.

(3) Company Culture

It is important to establish a strong corporate culture and a unique corporate style that emphasizes performance evaluation and budget management.

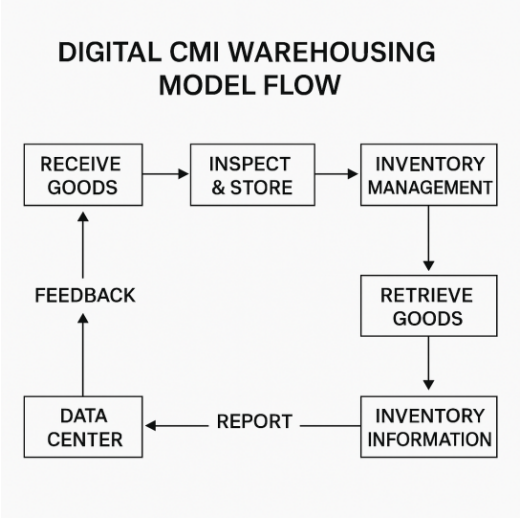
(4) Information Technology

Introducing an information management system will digitize procurement management, greatly reducing information blockages and human error rates during the procurement process.

5.3 Optimization of Inventory Management in the Supply Chain

The introduction of the CMI (Customer Managed Inventory) warehousing model focuses on managing inventory within the customer's internal warehouse, allowing the customer to handle the management independently. This approach ensures that the inventory holder (the customer) can forecast demand and match it with actual needs. Furthermore, based on this model, suppliers can use inventory data provided by the information center to make optimal adjustments to purchased products, reducing discrepancies between procurement volume and production requirements. Jinhuai Q Enterprises also categorizes its inventory into strategic materials, key materials, and leverage materials, applying different management methods to each category. This approach enables more efficient inventory management and ensures better control over material usage.As shown in Figure 8 informational CMI (Customer Managed Inventory) warehousing model flowchart.

Fig. 8. Flowchart of Informative CMI (Customer Managed Inventory) Warehousing Model



5.4 Optimization of Supplier Management in the Supply Chain

(1) Strengthening Cooperation with Suppliers

1.Direct Participation in Supplier Development

Jinhuai Q Enterprises regularly dispatches technical personnel to assist suppliers in solving technical challenges, thereby

improving their product quality. An incentive mechanism is employed to reward outstanding suppliers each season or year.

2.Multi-Channel Information Collection During Supplier Evaluation

To enhance the supplier evaluation process, Jinhuai Q Enterprises has increased the use of surveys and on-site visits to suppliers. This helps to gather more comprehensive and accurate data, reflecting the true condition of suppliers.

(2) Optimizing the Supplier Evaluation and Selection System

1.Supplier Evaluation System Change

Supplier evaluations were previously conducted by individual procurement departments. Now, the procurement department takes the lead, and all production departments are included in the evaluation and review process. Specific steps for supplier evaluation are outlined in Table 3 and Table 4, which illustrate the evaluation criteria and weightings.

2.Refinement and Classification of Suppliers

Jinhuai Q Enterprises has further refined and categorized suppliers, ensuring that evaluations are tailored to the needs of different supplier categories.

3.Optimization of Supplier Evaluation Elements

The elements of supplier evaluations have been optimized to focus primarily on a weighted scoring method, ensuring that evaluations are both fair and objective.

Table 3 Supplier evaluation weights

Item	Weighting
Quality	30%
Price	20%
Delivery on time	15%
Sales Service	15%
Location	10%

Table 4 Classification of suppliers

Classification	Materials supplied
Category A suppliers	Major or critical components required for production
Category B suppliers	Minor components required for production
Category C suppliers	Auxiliary materials for production

6.Conclusion and Outlook

6.1 Conclusion

This study examines the current state of the supply chain operations at Jinhuai Q Enterprises, identifying both opportunities and challenges in the company's path towards sustainable development and carbon neutrality. Through an in-depth analysis of the company's upstream planting, midstream processing, and downstream consumption operations, several critical issues have been highlighted, such as the fragmented distribution of planting bases, low mechanization in processing, and insufficient sustainability in downstream sales channels. Additionally, the company faces challenges in inventory management, supplier coordination, and employee turnover. These challenges significantly impact the efficiency, stability, and sustainability of the supply chain.

In response, several strategies have been proposed, including the promotion of large-scale and intensive planting, the adoption of more advanced processing technologies, the optimization of supplier management, and the development of a carbon-neutral supply chain. These measures aim not only to strengthen Jinhuai Q Enterprises' competitive position but also to align the company with China's "dual carbon" goals and contribute to sustainable agricultural practices. Through improved

supply chain management and technological innovation, Jinhuai Q Enterprises can enhance its operational efficiency, reduce environmental impact, and achieve long-term growth.

6.2 Outlook

Looking ahead, Jinhuai Q Enterprises has a unique opportunity to further strengthen its supply chain by adopting digital technologies and green logistics practices. The integration of advanced information management systems and the optimization of logistics networks will be critical in enhancing real-time inventory tracking, improving demand forecasting, and reducing inefficiencies. Furthermore, greater collaboration with key suppliers, along with the establishment of strategic partnerships, will play a crucial role in ensuring a stable supply of raw materials and fostering innovation.

The company should also continue to focus on product diversification, expanding its range of Jinhuai-based products, and exploring new market segments, particularly in health and wellness industries. By enhancing its market presence and leveraging its strong product offerings, Jinhuai Q Enterprises can better capitalize on the growing consumer demand for sustainable and eco-friendly products.

In the longer term, as global climate policies continue to evolve and consumer preferences shift towards sustainable products, Jinhuai Q Enterprises is well-positioned to become a leader in the green agricultural supply chain sector. However, achieving these goals will require continuous investment in innovation, effective management practices, and proactive engagement with stakeholders across the supply chain.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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