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Study on the Supply Chain Channels of Agricultural Products in Guangzhou for Building the Guangdong-Hong Kong-Macao Greater Bay Area under the Rural Revitalization Strategy

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Abstract: The purpose of this paper is to explore the development trend of agricultural supply chain channels, and combined with the current research status at home and abroad, and guided by the strategy of rural revitalization, a new model of agricultural supply chain channels is proposed through the analysis of the pilot case in Guangzhou. The model integrates information from three production cycles: pre-production, in-production and post-production, aiming to better meet farmers' needs. The study finds that to achieve effective operation of agricultural supply chains, it is necessary to strengthen the development of agricultural specialty industries, vigorously promote IT, and make full use of human resources. The focus is on rural revitalization and agricultural supply chains, as well as their related channels.

1. Introduction

The Rural Revitalization Strategy stands as a crucial national initiative in China, dedicated to advancing rural economic growth, enhancing the well-being of farmers, and fostering the harmonious development of urban and rural regions [1]. Being the central city within the Guangdong-Hong Kong-Macao Greater Bay Area, Guangzhou holds a pivotal role, with its agricultural resources and products serving as key contributors to the broader rural revitalization efforts. Examining the establishment of agricultural supply chain channels for farm products in Guangzhou, within the Guangdong-Hong Kong-Macao Greater Bay Area, provides an opportunity to delve into the intricate dynamics between urban and rural spheres. Such exploration aims to enhance the efficiency of agricultural product distribution, ultimately fostering the sustainable evolution of the rural economy [2].

Currently, the rural revitalization strategy has become an important strategy at the national level in China, aiming to promote the development of rural economy and improve the living standards of farmers. Guangzhou, as the core city of the Guangdong-Hong Kong-Macao Greater Bay Area, its role in this strategy is particularly important. In recent years, researchers have conducted in-depth studies on Guangzhou's construction of agricultural supply chain channels in the Guangdong-Hong Kong-Macao Greater Bay Area in order to explore how to better promote the integrated development of urban and rural areas, improve the efficiency of the circulation of agricultural products, and promote the revitalization of the countryside [3].

Scholars first focus on the impact of the rural revitalization strategy at the national policy level. The national policy orientation for rural economic development is examined, especially the impact of the promotion of the rural revitalization strategy on Guangzhou and the surrounding areas. This includes the government's policy support for the structural adjustment of the agricultural industry, the improvement of farmers' income, and the construction of rural infrastructure [4]. Studies on the construction of agricultural supply chain channels in Guangzhou for the Guangdong-Hong Kong-Macao Greater Bay Area have focused on optimizing the agricultural product distribution system and improving supply chain efficiency. Scholars have proposed a series of specific and feasible solutions through in-depth research on market demand, agricultural product production, logistics and transportation, and other aspects of data [5]. This covers the optimization of the whole chain from the production end to the sales end, including the application of agricultural science and technology, the enhancement of packaging and labeling of agricultural products, and the improvement of the logistics system. At the same time, researchers have emphasized Guangzhou's geographical advantage and economic radiation within the Guangdong-Hong Kong-Macao Greater Bay Area [6]. Focusing on Guangzhou's position as a hub for the distribution of agricultural products in the region, it is proposed that under the strategy of rural revitalization, Guangzhou can promote faster access to the market for agricultural products in the region through the construction of a more efficient supply chain for agricultural products to achieve a mutually beneficial win-win situation for both rural and urban areas [7].

This paper emphasizes the important role of science and technology innovation in the agricultural supply chain by introducing advanced information technology and Internet of Things (IoT) technology, etc., to improve the monitoring and management level of the production and circulation of agricultural products in order to cope with the rapid changes in the market and the individualization of consumer demand.

2. Construction Ideas

2.1 Supply chain process

Supply chain refers to a network structure that encompasses upstream and downstream organizations involved in the production and distribution process with the goal of delivering a product or service to the end user [8]. A supply chain is a complex set of activities involving multiple interactions, such as payment for goods, orders, services, and products. The operations are carried out by several firms, where each of them is responsible for improving the quality of the product, reducing the productivity, and ensuring competitiveness in the market [9]. Through comprehensive monitoring of the supply chain, it is possible to better control the operation of the enterprise, improve its efficiency, and achieve long-term sustainable growth. In the supply chain, the two-way flows of logistics, capital flow and information flow are intertwined, and together they build a complex and close collaboration network. Specifically as shown in Figure 1 [10].

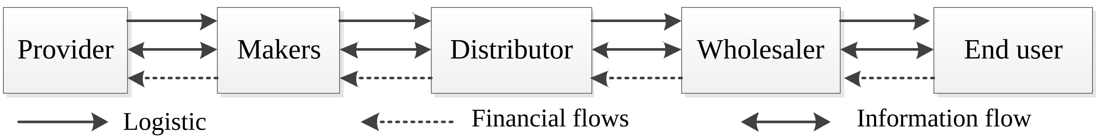

Figure 1: Supply chain process

An agricultural supply chain is a network of upstream and downstream organizations and a chain structure involving the production and distribution of agricultural products and the provision of products or services to end-users. By taking various factors into account, it is possible to develop a complete, effective and long-term supply chain management model that covers the entire history of agricultural development. This model will cover the entire development from planting to harvesting, marketing, and then consumption, and can effectively control the transmission of material, financial resources, and information. Throughout the process, not only enterprises from various channels, such as the supply chain, manufacturers, distributors, sellers, and customers, but also material, financial, and information factors will be taken into account. This integrated perspective can fully grasp all aspects of the agricultural supply chain to ensure comprehensive planning and effective management [11]. According to the complete process and cycle, the design of the agricultural supply chain should focus on logistics, finance, and information, and adopt an integrated innovation model to construct these three channels, as shown in Table 1.

Table 1: Supply chain channels

		Pre-production stage	Perinatal stage	Postnatal period
Logistics capital flow information flow	Supplier	Agricultural production materials (agricultural machinery, seeds) Agricultural products producers	Agricultural products processing enterprises	Agricultural products (farmers, cooperatives, production sites)
	Manufacturers	Agricultural products wholesale market	Agricultural products processing enterprises	Agro-processing enterprises
		Agricultural supply stores	Agricultural Products Wholesale Market	Agricultural produce wholesale market
	Wholesalers	Farmers, cooperatives, production	Agricultural products stores	Supermarkets, farmers' markets
	Retailers	Production bases Logistics, capital flow, information flow	Farmers, cooperatives, production bases	Communities, schools, factories
	End Users	Information flow	Logistics, capital flow, information flow	Logistics, capital flow, information flow information flow

2.2 Construction Mode

In building the Guangdong-Hong Kong-Macao Greater Bay Area Food Supplier Pathway, Guangzhou focuses on the development of the Food Supply Chain Logistics Pathway, the Food Supplier Financing Pathway, and the Food Supplier Information Pathway. This forms a comprehensive development model, in which the agricultural supply chain logistics channel serves as a key operational system whose mission is to promote the green circulation of agricultural products and ensure efficient transportation from the place of production to the consumer's table. The agricultural suppliers' financial channel plays the role of a guarantee mechanism, aiming to ensure smooth financing for the production, circulation and sales of agricultural products. At the same time, the Agricultural Supplier Information System Channel builds a comprehensive service system dedicated to enhancing data transparency and smoothness in the production, distribution and marketing of agricultural products. These three channels are intertwined to create a comprehensive and powerful development framework for Guangzhou's agricultural suppliers, helping them move to a higher level in the modernized agricultural system.

The construction concept of Service + Technology + Layout provides a brand new framework for the agricultural supply chain logistics channel in the Guangdong, Hong Kong and Macau Greater Bay Area, and service becomes the core element of it, organically combining the integrated logistics service model of 1+N in order to promote the win-win interests of all parties and to realize the efficient and sustainable development of the agricultural supply chain[12]. 1 refers to the farmers, and N refers to other supply chain participants, such as Farmers + leading enterprises + base, farmers + cooperatives + supermarkets, etc., which together constitute a complete supply chain system [13]. In the agricultural supply chain logistics channel, the application of technology is crucial, because it is directly related to the quality of agricultural products, which in turn affects the safety of agricultural products and brand promotion. Taking cold chain technology as the main breakthrough point, green ecological trading of agricultural products can be realized through the establishment of e cold chain double-sided logistics and distribution system [14]. In this way, it can achieve an all-round coverage of the food circulation area in the Guangdong, Hong Kong and Macao Greater Bay Area and improve the overall service level of food logistics and distribution [15].

3. Experimental Argumentation

3.1 Experimental preparation design

In order to verify the effect of the designed channel in practical application, an organic agricultural products enterprise was selected as the experimental object, which is representative of the Guangzhou area and helps to understand the characteristics and problems of the agricultural products supply chain in Guangzhou area more comprehensively. A new supply chain management system for agricultural products is designed, aiming at integrating big data and cloud computing technologies to improve the operational efficiency and data management level of the supply chain. Meanwhile, the big data-based management system and the cloud computing-based management system are used as comparative systems, which are labeled as traditional system 1 and traditional system 2, respectively. In the experiment, participants of the organic agricultural supply chain of an enterprise, including suppliers and users, are required to perform a series of operations in the three systems, such as product information querying, supplier information querying, product uploading and management, product traceability, and product anti-counterfeiting verification, information uploading, information sharing and information modification. Each operation was tested with several repetitions to obtain more stable and reliable experimental data. This helps to eliminate the influence of random factors and evaluate the system performance more accurately.

3.2 Experimental results and discussion

The response performance of the three systems was comprehensively evaluated by using response time as the evaluation index. After the user logged into the system through the client, several operations including organic agricultural product information query, supplier information query, product upload management, product traceability, product anti-counterfeiting verification, product supply chain information uploading, product supply chain information sharing, and information modification were executed. In each operation, we conducted 10 repetitive tests to record the system response time by using iYHA software. The specific measurement method starts from the time when the user sends a request for supply chain management service, and continues until the system displays the corresponding information. For each operation, the average response time of the 10 tests was taken as the final test result, as shown in Table 2.

As can be seen from the data in Table 2, the design system exhibited relatively short response times in this experiment, which ranged from 0.25 to 0.51 seconds. The design system succeeded in keeping the response time within 1 second, which shows its efficient response performance in practice. In comparison, the response time of the conventional system 1 ranges from 4.15 to 5.46

seconds, with an average response time nearly 5 seconds slower than that of the design system, while the response time of the conventional system 2 ranges from 4.25 to 6.25 seconds, which is nearly 6 seconds slower than that of the design system.

Table 2: System response performance

Operation items	Designed systems/%	Traditional systems1/%	Traditional systems/2%
Product Information Inquiry	0.36	5.46	5.32
Supplier Information Inquiry	0.45	3.58	5.13
Product Upload Management	0.38	5.24	5.45
Product Traceability	0.33	5.13	6.25
Product anti-counterfeiting verification	0.41	4.35	6.03
Supply Chain Information Upload	0.36	4.15	4.58
Supply Chain Information Sharing	0.51	4.25	4.44
Information Modification	0.25	4.41	4.25

To further validate the applicability of the designed system, experiments were conducted with the number of validations as the variable. The results of the data obtained through the corresponding calculations are shown in Table 3. This experimental design aims to gain insight into whether the response performance of the designed system can remain stable under different validation counts, and to provide a more detailed validation of the reliability and continuity of the system.

Table 3: Comparison results of error rate

Number of validations/times	Designed system product validation error rate/%	Legacy system 1 product validation error rate/%	Legacy system 2 product validation error rate/%
1000	0.05	3.14	4.15
2000	0.12	4.51	4.86
3000	0.16	4.96	5.26
4000	0.18	5.16	5.86
5000	0.22	5.68	6.49
6000	0.26	6.23	7.48
7000	0.28	7.45	8.52
8000	0.35	8.26	9.96

By observing the data in Table 3, it can be learned that although the error rates of the three systems gradually increase as the number of validations increases, it is noteworthy that the error rate of the design system is always lower than that of the two traditional systems. When the number of validations reaches 8000, the error rate of the design system is only 0.35%. The design system is able to keep the error rate within 1% in the experiment, which is significantly better than the two traditional systems. This experiment proves that the design system presents significant advantages in terms of response time and accuracy of product information anti-counterfeiting verification.

4. Conclusion

In this study, the focus will be on the construction of agricultural supply chains. Guangzhou will be used as a model for the Guangdong-Hong Kong-Macao Greater Bay Area, and these experiences will be utilized to promote agricultural development. A new approach is proposed to realize efficient production and sustainable development of agricultural products by integrating the three channels of logistics, capital flow and information flow with each other. Through the establishment of a comprehensive operation, guarantee and service system, the green logistics, secure capital and intelligent supply chain information channels of agricultural products in the Guangdong-Hong Kong-Macao Greater Bay Area are effectively supported, thus making the production and supply of agricultural products in the Guangdong-Hong Kong-Macao Greater Bay Area more standardized, and providing a reliable guarantee for the international development of agricultural products in Guangzhou.

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