Research on Performance Evaluation Index System of Agricultural Product Supply Chain Operation in County Area：Based on Improved SCOR Model

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Abstract

With the implementation of rural revitalization strategy and the help of new retail model, county agricultural products have ushered in unprecedented development opportunities. In order to promote the further development of agricultural products, it is of great practical significance to evaluate and optimize the operation performance of county agricultural product supply chain. According to the characteristics of county agricultural product supply chain under the new retail mode, an improved SCOR model is constructed and its process is analyzed in detail. On the above basis, six first-level indicators are set with using the top contents of the improved SCOR model, and then subdivided into 18 second-level indicators according to the actual situation involved in the first-level indicators, thus establishing a complete evaluation index system for the operation performance of agricultural product supply chain in counties. The research can provide guidance and reference for the enterprises and farmers related to agricultural products to evaluate the supply chain in county area.

Keywords

Agricultural product; County Area; Supply Chain; Evaluation index; SCOR model.

1. Introduction

With the implementation of the rural revitalization strategy in China, the dividend of agricultural industrialization development has been further released. Agricultural products are the core of agricultural industrialization development, and the rural revitalization strategy provides a new opportunity for the development of agricultural products. At the same time, digital, information, Internet and other technologies have spawned a new retail model. The new retail model deeply changes people's consumption habits and affects the whole process of enterprise product's production, circulation and distribution with the support of digitalization, Internet and other technologies. On the one hand, it can help agricultural enterprises and farmers in the county to sell agricultural products to all parts of the nation and realize economic income increase. On the other hand, it can also help agricultural enterprises and farmers in the county to buy back the needed agricultural materials and help the high-quality development of agricultural products. In addition, under the new retail model, consumers' demands and services for agricultural products are rising, and agricultural products consumption is forming a brand-new consumption concept. Consumers not only pursue product taste and processing methods, but also pay attention to the freshness, quality and safety of agricultural products. Consumers are demanding more and more services such as diversified demand for agricultural products, efficient transportation, and quick handling of return and exchange.

Therefore, in order to achieve safe, efficient and high-quality delivery of agricultural products to consumers, improve consumer satisfaction and reduce operating costs, county-level agricultural enterprises and farmers need to work hard on supply chain operation. Only when agricultural enterprises and farmers fully understand the operation state of their own agricultural product supply chain can they analyze the existing problems and optimize them, thus improving the operation performance of their own supply chain. Therefore, in order to help agricultural enterprises and farmers understand the operation of their own supply chains, it is necessary and valuable to establish a suitable performance evaluation index system for agricultural supply chains.

In recent years, many scholars have studied the evaluation index system of agricultural product supply chain. For example, Li and Liu (2017) constructed the risk evaluation index system of agricultural product supply chain from seven aspects: planting, organization, circulation, processing, supply, demand and environment. Yan et al. (2019) established an effective risk assessment method of agricultural supply chain based on conditional value at risk. Dai and Liu (2020) introduced the new risks faced by the supply chain of agricultural supermarkets after the introduction of big data from the aspects of production, processing, distribution, retail and consumption, and then conducted risk assessment by combining qualitative analysis and quantitative calculation. Li (2022) established an evaluation index system of brittle source hierarchy with internal and external factors as the criterion layer and the complexity, characteristics, control and circulation process, consumer demand, product life cycle and form diversification, natural environment, economic and social environment as the factor layer. Gao (2018) designed 15 indicators from three aspects: exposure, interference and adaptability, and established the corresponding evaluation system based on the vulnerability assessment model. Zhang and Wang (2020) constructed an index system of fresh-keeping efforts in Agricultural Product supply chain from the perspective of fresh-keeping efforts, which included 6 first-level indicators and 20 second-level indicators. The evaluation index systems of the above researches are mainly related to the supply chain risk, brittleness and the level of fresh-keeping efforts, and have never involved the operational performance. Therefore, some scholars focus on the performance evaluation of agricultural product supply chain. For example, Cao and Fan (2017) focus on building a new evaluation index system from four aspects: economy, supply chain operation, innovation and environment. Zhou (2020) established the performance evaluation index system of agricultural product supply chain considering the particularity of agricultural product supply chain and combining the performance evaluation theory of balanced scorecard. Jiang et al. (2017) combined SCOR, balanced scorecard and key performance indicator model to establish the performance evaluation index system of integrated operation of agricultural product supply chain. Liu et al. (2020) built a performance evaluation system model of agricultural green supply chain on the basis of studying the connotation of agricultural green supply chain. Han et al. (2021) constructed a performance evaluation index system of agricultural product supply chain from three aspects: production capacity, logistics capacity and sales capacity. Ding and Kong (2023) established a performance evaluation index system of Agricultural Product supply chain under the background of agricultural and commercial interconnection from four aspects: production, business process, logistics and consumers. Although these studies are aimed at the operation performance of agricultural supply chain, they have not set up a suitable evaluation index system for the operation performance of agricultural supply chain according to the current new retail model and the actual situation of agricultural products in counties.

In view of the lack of research and practical needs, the sales process is added to the basic model to establish an improved SCOR model with considering the current situation that agricultural enterprises and farmers in the county have the ability to sell independently under the background of the new retail model. A detailed and complete evaluation index system for the

operation performance of county agricultural product supply chain is established by using the improved SCOR model. It is expected to provide guidance and reference for relevant county agricultural enterprises and farmers in the performance evaluation of supply chain operation.

2. Analysis of County Agricultural Product Supply Chain Based on Improved SCOR Model

2.1. Process structure of improved SCOR model

SCOR model is a supply chain diagnosis tool, which can help enterprises to implement effective supply chain operation. The top layer of SCOR model includes five processes: planning, purchasing, production, distribution and return. Its evaluation can measure the performance of supply chain, reflect the performance characteristics of supply chain and gain insight into the problems of each link. However, the SCOR model does not include an independent sales process. The sales process is the content of order management which is weakened and put in the distribution process. That may be because the previous supply chain operation mode mainly focused on manufacturing and did not pay attention to sales. However, with the improvement of people's quality of life and the improvement of consumers' requirements for products and services, the market has changed from manufacturing-centric to customer-centric. At the same time, under the new retail mode, county-level agricultural enterprises and farmers who play the role of "manufacturers" in the agricultural product supply chain began to join the retail ranks, using various networks, e-commerce and media platforms to directly sell their agricultural products. The sales process has become one of the main businesses of agricultural enterprises and farmers. Therefore, in the SCOR model, it is very necessary to analyze sales process independently as an important link.

Under the current new retail mode, considering the fact that county-level agricultural enterprises and farmers have the ability of online self-sales, the order management content in the distribution process is extracted as an independent sales process, which is treated and analyzed equally with the planning process, the procurement process, the production process, the distribution process and the return process. Therefore, the sales process is added to the basic SCOR model. The whole process includes six major processes: planning, purchasing, production, sales, distribution and return. It is shown in Figure 1.
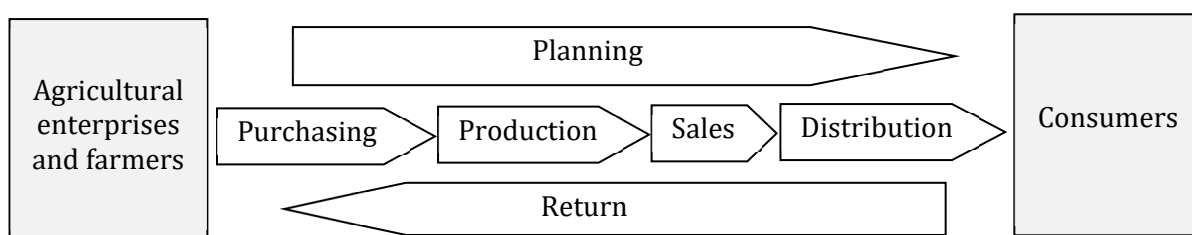

Figure 1. The top six processes of the improved SCOR model

2.2. Process analysis of county agricultural product supply chain based on improved SCOR model

According to the improved SCOR model constructed in Figure 1, the top layer of it includes six processes: planning, purchasing, production, sales, distribution and return, covering the whole circulation process of supply chain operation. Based on that, the following will analyze the contents of the six major processes of county agricultural product supply chain.

2.2.1. The planning process

The planning process is a plan made by agricultural enterprises or farmers in order to achieve business objectives, according to market information and consumer demand, as well as personal goals and overall supply chain goals. When the agricultural products planted by growers do not match the market demand, and the business plan is not coordinated with the individual or the overall goal of the supply chain, the supply of agricultural products will be insufficient or excessive. That will also lead to an increase in operating costs, a decline in consumer satisfaction and the income of the supply chain. Therefore, before planting agricultural products, agricultural enterprises and farmers should make a reasonable production plan based on product sales forecast, upstream and downstream information and product demand in previous years, in order to achieve a state of balance between supply and demand. Moreover, when making planting plans, agricultural enterprises and farmers should communicate and coordinate with their partners in the supply chain, so as to provide a good foundation for later procurement, processing, sales and distribution.

2.2.2. The purchasing process

The procurement process is the first link in the physical flow of the supply chain, covering the selection of agricultural suppliers, purchase orders, transportation and delivery. This process directly affects the planning and implementation of each process in the later period. The time, quality and delivery time of purchasing agricultural materials will affect the quality of planted products and the later sales and delivery operations. The implementation effect of the procurement process is closely related to the selected suppliers. High-quality suppliers can provide high-quality products, deliver on time and ensure transportation. Therefore, agricultural enterprises or farmers should choose suitable suppliers and establish long-term cooperative relations according to the quality and service level of agricultural materials needed to ensure the availability, quality and related services of materials needed for planting. Moreover, in the process of cooperation with suppliers, it is necessary to carry out supplier management, maintain information communication, conduct technical training, and appropriately adjust supplier members.

2.2.3. The production process

The production process is the planting process and the most critical link in the supply chain of agricultural products, which directly affects the quality of plants and their later sales. At present, there are different types of agricultural production organization modes, such as individual decentralized production, participation in rural cooperatives, joint production and so on. Different modes of agricultural production organization have different numbers of farmers, planting equipment, information sources and technology application that will directly affect the quality and quantity of agricultural products. The biggest shortcomings of the individual decentralized production mode with family as the unit are low degree of organization, lack of cooperation with other enterprises, and few channels to obtain market information. In addition, the processing mode of agricultural products also has an impact on enterprise performance. Some agricultural enterprises and farmers are good at producing and selling agricultural products with added value by using processing technology according to the diversified needs of consumers, thus improving their income. Therefore, it is very important to choose a suitable production organization mode, have a certain reprocessing process and pay attention to the production process.

2.2.4. The sales process

The choice of sales methods will directly affect the sales volume, sales price, sales scope, backlog or shortage of agricultural products. Some small and scattered farmers with families as the unit may be limited to traditional sales channels, and the agricultural products they sell are mainly primary products. This will make it difficult for them to improve their income, and the primary

products they sell are also prone to the problems of short sales cycle, perishable and difficult to store. With the help of new retail, some agricultural enterprises and farmers can sell their agricultural products to more users through the network, which can get greater benefits. In addition, in the sales process, it is also helpful for the performance of enterprises to fully meet the consumer demand, stabilize the difference between supply and marketing, pay attention to the needs of consumers and do a good job in customer maintenance. Therefore, the choice of sales methods, the difference between supply and demand and customer maintenance will affect the operation performance of agricultural product supply chain.

2.2.5. The distribution process

The distribution process is the last link in the positive flow of Agricultural Product supply chain, and it is also the closest link to the end consumers. In addition to the production quality of agricultural products, consumers attach great importance to the service of this link. This is because the distribution of agricultural products is the most likely to cause damage and decay of agricultural products, which will directly affect the quality of agricultural products. For agricultural enterprises and farmers, this link is very risky, and it is easy to cause problems such as loss of agricultural products, increased operating costs and untimely product distribution. Therefore, according to the distribution process of agricultural products, reasonable selection of cold chain equipment, transport vehicles and other facilities will help reduce the decay rate and damage rate of agricultural products, thus improving consumer satisfaction.

2.2.6. The return process

The return process is a link of reverse physical flow in agricultural product supply chain, which directly affects the satisfaction of end consumers. Because fresh agricultural products are perishable, have short storage time, and have high requirements for transportation, it is easy for agricultural products to rot and cause products to be returned. Defective quality of agricultural products and slow response time of returning goods will lead to consumer dissatisfaction. It will cause the frequency and quantity of products purchased by consumers again, resulting in low performance of agricultural product supply chain operation. Therefore, in view of the impact of return and exchange on agricultural products, all members in the supply chain of agricultural products should pay attention to the content management of return and exchange process, handle the return and exchange problem in time and properly, and improve consumer satisfaction.

3. Performance Evaluation Index System of County Agricultural Product Supply Chain Operation

According to the analysis of the previous section and drawing lessons from the research of scholars such as He (2022), Ma (2020) and Lima-Junior (2020), the improved SCOR model is used to design performance evaluation index of county agricultural supply chain operation. From a comprehensive and systematic point of view, the top six processes of the improved SCOR model are set as six first-level indices, and then 18 second-level indices are set on this basis, thus forming a complete evaluation index system, as shown in Table 1.

The planning process index includes four second-level indices: demand forecasting information source, matching degree between plan and demand, treatment scheme of plan imbalance and degree of information sharing. The demand forecasting information source index can judge the richness of information sources of agricultural enterprises and farmers when forecasting demand. The more abundant the information source is, the more accurate the forecast will be, which is helpful to improve the operation performance of agricultural product supply chain. The matching degree between plan and demand index can evaluate the matching between the

business plans made by agricultural enterprises and farmers in the past and the actual market demand. The higher the matching degree is, the higher the operation performance of its agricultural product supply chain will be. The treatment scheme of plan imbalance index can evaluate the perfection of the solution of agricultural enterprises and farmers when the plan and market demand are unbalanced. The more perfect the scheme is, the higher the operational performance of its agricultural product supply chain will be. The degree of information sharing index can evaluate the information sharing degree of upstream and downstream members about the consumer market. The higher the degree of information sharing is, the higher the operational performance of its agricultural product supply chain will be.

The purchasing process index includes three second-level indices: quality of purchased agricultural materials, acquisition rate of purchased agricultural materials and degree of flexibility in procurement. The quality of purchased agricultural materials index can evaluate the quality of agricultural materials provided by upstream suppliers. The acquisition rate of purchased agricultural materials index can evaluate the satisfaction rate of products provided by upstream suppliers. The degree of flexibility in procurement index can evaluate the perfection of solutions of agricultural enterprises and farmers when suppliers are in short supply. These three secondary indicators can evaluate the performance of the purchasing process.

The production process index includes three second-level indices: production organization mode, completion rate of production plan and agricultural product processing mode. The production organization mode index can evaluate what kind of production organization mode agricultural enterprises and farmers are in, so as to judge the planting equipment and technology application of growers in the production process. The more advanced and skillful the planting equipment and technology are, the higher the operation performance of agricultural product supply chain will be. The completion rate of production plan index can evaluate the gap between the actual harvest output of agricultural products and the original planned output. The smaller the gap is, the higher the performance of the supply chain will be. The agricultural product processing mode index can evaluate whether there is a value-added processing link in agricultural products and its processing level. The operation performance of supply chain with high value-added processing links is generally higher.

The sales process index includes three second-level indices: agricultural product sales mode, gap rate between supply and sale and degree of customer relationship management. The agricultural product sales mode index can evaluate the advantages of sales channels and methods adopted by agricultural enterprises and farmers. Generally speaking, Omni-Channel sales mode is helpful to improve the operation performance of supply chain. The difference rate between supply and sale index can evaluate the supply of consumer demand and the balance between supply and sale. The lower the difference between supply and marketing is, the higher the performance of supply chain will be. The degree of customer relationship management index can evaluate the degree of relationship maintenance and management between agricultural enterprises and customers. Maintaining and managing customers is helpful to increase sales and improve the operation performance of supply chain.

The distribution process index includes three second-level indices: product delivery punctuality rate, loss rate of product distribution and perfection of distribution facilities. The product delivery punctuality rate index can measure the probability that agricultural products will be delivered to customers on time. The loss rate of product distribution index can measure the loss rate of agricultural products when they arrive at customers. The higher the product delivery punctuality rate and the perfection of distribution equipment are, the higher the operation performance of agricultural product supply chain will be. The perfection of distribution facilities index can evaluate the freshness of agricultural products when they arrive

at customers. The lower the loss rate of product distribution is, the higher the operation performance of agricultural product supply chain will be.

The return process index includes return rate index and return processing time second-level index. The return rate index can evaluate the return situation of agricultural products. Generally speaking, the higher the return frequency is, the lower the performance of the supply chain will be. The return processing time second-level index can evaluate the time required for agricultural enterprises and farmers to complete the return order. The higher the return processing time and the lower the customer satisfaction are, the lower the operation performance of the supply chain will be.

Table 1. Evaluation index system

Indices	First-level indices	Second-level indices
Performance evaluation index system of county agricultural product supply chain operation	Planning process	Demand forecasting information source
		Matching degree between plan and demand
		Treatment scheme of plan imbalance
		Degree of information sharing
	Purchasing process	Quality of purchased agricultural materials
		Acquisition rate of purchased agricultural materials
		Degree of flexibility in procurement
	Production process	Production organization mode
		Completion rate of production plan
		Agricultural product processing mode
	Sales process	Agricultural product sales mode
		Gap rate between supply and sale
		Degree of customer relationship management
	Distribution process	Product delivery punctuality rate
		Loss rate of product distribution
		Perfection of distribution facilities
	Return process	Return rate
		Return processing time

4. Conclusion

With the implementation of rural revitalization strategy and the development of new technologies such as big data and Internet, the new retail model has emerged. It provides vitality for the development of agricultural products in rural areas, but also quietly changes people's consumption concept, making consumers pay more and more attention to the quality, distribution, return and exchange of agricultural products and other supply chain issues. In order to help agricultural enterprises and farmers to further optimize their agricultural product supply chains and increase their operating income, based on the characteristics of county agricultural product supply chains under new retail and the improved SCOR model process, a complete evaluation index system for the operation performance of county agricultural product supply chains is established.

The evaluation index system includes six first-level indices: the planning process, the purchasing process, the production process, the sales process, the distribution process and the return process. The planning process index includes four second-level indices: demand forecasting information source, matching degree between plan and demand, treatment scheme of plan imbalance and degree of information sharing. The purchasing process index includes

three second-level indices: quality of purchased agricultural materials, acquisition rate of purchased agricultural materials and degree of flexibility in procurement. The production process index includes three second-level indices: production organization mode, completion rate of production plan and agricultural product processing mode. The sales process index includes three second-level indices: agricultural product sales mode, gap rate between supply and sale, degree of customer relationship management. The distribution process index includes three second-level indices: product delivery punctuality rate, loss rate of product distribution, perfection of distribution facilities. The return process index includes return rate and return processing time second-level indices.

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