Research on the Management Model and Performance Evaluation of Guangxi ASEAN Cross border Agricultural Product Supply Chain

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Abstract. With the proposal of the "Belt and Road Initiative", China's cross-border trade has been further developed. In order to comply with the development trend of "double cycle", the trade of agricultural products can make full use of "two resources and two markets" both at home and abroad. However, the supply chain of cross-border trade of agricultural products involves many links and has a wide range of chain coverage, showing relatively complex characteristics. In order to realize the sustainable development of cross-border agricultural products trade, an empirical study on the management model and performance evaluation of Guangxi-ASEAN cross-border agricultural products supply chain was carried out. On the basis of defining the concept of Guangxi-ASEAN cross-border agricultural product supply chain, this study first analyzed the management mode of Guangxi-ASEAN cross-border agricultural product supply chain, designed the performance evaluation model of Guangxi-ASEAN cross-border agricultural product supply chain according to the importance of cross-border logistics and demand of agricultural products, and then set evaluation indicators on the basis of target level and criterion level through the selection rules of evaluation indicators. Principal component analysis was used to evaluate the scores of each index, so as to obtain the evaluation level of Guangxi-ASEAN cross-border agricultural supply chain performance, and complete the empirical analysis of performance evaluation. The empirical analysis results are as follows: The logistics system of Guangxi-ASEAN cross-border trade is gradually improved, the delivery timeliness and accuracy of cross-border trade are constantly increasing, the quality of cross-border agricultural products is gradually enhanced, and the information exchange of cross-border trade is becoming more transparent. This improves the satisfaction of consumers, increases the profits of enterprises, reduces the customs clearance time and finished products of agricultural trade, and strengthens the close trade cooperation between Guangxi and ASEAN countries.

Keywords： trade cooperation; Cross border agricultural product supply chain; Management mode; Empirical analysis; Trade performance.

1. Introduction

China has a close geographical relationship with ASEAN, and the two sides have maintained economic and trade exchanges for hundreds of years in the long history. Since the establishment of China-Asean Free Trade area, the trade between China and ASEAN countries has been freer, and its trade exchanges have maintained friendly relations, and the cooperation between the two sides in politics and economy as well as culture and society has been deepening. In this context, the trade between China and ASEAN countries has become more frequent, and the trade in goods, services and investment trade have been increasing. With the extensive development of trade relations between China and ASEAN, ASEAN has become the second largest cooperation partner of China, and new trade forms and development models have emerged, especially in the cross-border trade of agricultural products, and its development speed has gradually increased. With the continuous maturity of Internet technology, information technology and infrastructure equipment, a variety of

science and technology constantly stimulate the trade development of our country and ASEAN countries. In recent years, in order to achieve the further development of cross-border trade of ASEAN, play the important influence of China's agricultural country, and constantly transform the mode of cooperation in ASEAN trade exchanges [1]. This time, taking the Guangxi-ASEAN cross-border agricultural product supply chain as the research object, in order to realize the management mode analysis and performance evaluation of ASEAN cross-border trade, an evaluation model is designed to carry out empirical analysis on the performance of ASEAN cross-border agricultural product supply chain, so as to provide a basis for the sustainable development of cross-border cooperation.

2. Definition of Guangxi-ASEAN cross-border agricultural supply chain

After the cross-border trade of agricultural products has gradually become a hot topic, the research on the supply chain related issues of cross-border agricultural products has begun to attract worldwide attention. In order to analyze the management model of Guangxi-ASEAN cross-border agricultural product supply chain and evaluate the supply chain performance, the concept of agricultural product supply chain is first defined [2]. Due to the importance of trade supply chain in cross-border procurement, Guangxi-ASEAN cross-border agricultural supply chain has become an important part of ASEAN cross-border procurement. With the development of global economic integration, countries in the world have formed a closely connected "global village". In view of the further development of this global pattern, the concept of Guangxi-ASEAN cross-border agricultural product supply chain can be defined as the information collection, product circulation and marketing process of agricultural products between Guangxi and ASEAN countries, and the import and export trade of agricultural products between countries and regions.

3. Guangxi-asean cross-border agricultural supply chain management model

As a large agricultural country in the world, China has a variety of high-quality agricultural products in the country, whether it is special wheat or peanuts as well as vegetables and Chinese medicinal materials, the output value of its products are in the forefront of the world. Under the domestic modern agricultural management mode, China's agricultural development has the characteristics of industrialization and systemization, attracting domestic and foreign enterprises to enter and realize the trade export of agricultural products [3]. In the cross-border trade of agricultural products between Guangxi and ASEAN, China mainly relies on the "One Belt, One Road" policy formulated by the country, and promotes trade development through the construction of free trade zones. The international recognition of agricultural products is gradually increasing. In order to study the performance of Guangxi-ASEAN cross-border agricultural products supply chain at this stage, it is necessary to analyze its management model first, which has the following characteristics:

(1) The particularity of logistics: no matter what kind of agricultural products, their freshness period is short, in the cross-border trade, the need for logistics time has a high requirement, so in the cross-border trade supply chain management, how to reduce product transportation is extremely important.

(2) Particularity of demand: With the continuous development of economy, people's quality of life continues to improve. In the cross-border trade of agricultural products, the important factor is the quality of products, and agricultural products are closely related to people's lives, so people will have higher requirements for the quality of agricultural products.

Based on the analysis of the logistics characteristics and demand characteristics of the agricultural product supply chain, the design of the Guangxi-ASEAN cross-border agricultural product supply chain management model should ensure both the cross-border transportation of agricultural products and the cross-border demand for agricultural products [4]. Based on the above

situation, this paper selects the relevant performance evaluation indicators to make an empirical analysis on the performance of ASEAN cross-border agricultural supply chain at this stage.

4. Guangxi-asean cross-border agricultural supply chain performance evaluation model

4.1 Determine the performance evaluation standards of Guangxi-ASEAN cross-border agricultural supply chain

The main purpose of constructing the evaluation model is to analyze the current supply chain of agricultural products trade between Guangxi and ASEAN countries, get the performance of the current supply chain, and then analyze the Guangxi-ASEAN cross-border product supply chain model. In order to scientifically reflect the objective situation of cross-border supply chain performance, it is necessary to develop a set of appropriate cross-border supply chain evaluation methods [5]. However, since the evaluation indicators cover a wide range, and the evaluation scale for cross-border trade can be large or small, it is necessary to select evaluation standards and establish matching performance evaluation rules in the actual operation process, so as to complete reasonable, scientific and fair performance evaluation. In order to highlight the key points of performance evaluation of cross-border agricultural products trade supply chain, the performance evaluation standards of this supply chain are set in the definition of relevant influencing factors of supply chain performance, as shown in Table 1.

Table 1 Performance assessment standards of Guangxi-ASEAN cross-border agricultural supply chain

Evaluation criterion	Specific meaning
Quantizable feature	Evaluation indicators should have objective value.
Is it understandable?	Understand the evaluation content and be familiar with the evaluation process.
There is correct guiding behavior.	After evaluation, it can produce suggestive behavior and eliminate unreasonable behavior.
Visualization feature	Any evaluation result can be obvious.
Definable feature	Each index can be defined.
Covering all aspects of cross-border trade	Include all aspects of the supply chain process, and make a comprehensive analysis of the input.Conduct a comprehensive analysis of the output.
Can important aspects be measured?	Including more valuable performance indicators, focusing on the practical value of trade supply chain.
Multidimensional feature	Comprehensively measure the relationship among supply chain utilization, productivity and trade performance.
Economy	Economic development of cooperative countries
Need to show trust and cooperation.	Trade between cooperative countries

As shown in the table, the evaluation criteria of cross-border trade supply chain are set according to different characteristics, and the supply chain performance is evaluated in various aspects, so as to ensure the multifaceted, fair and objective evaluation of cross-border agricultural trade supply chain [6-9]. Relevant standards can reflect the operation of the entire supply chain. In order to ensure the practicability of the performance evaluation of the agricultural trade supply chain through the setting of various rules and standards, it is necessary to divide multiple levels under the above standards to analyze the characteristics of the agricultural supply chain under different standards, so as to serve as the basis for the selection of indicators for the supply chain performance evaluation [10]. An objective evaluation method is used to set up the evaluation model construction criteria, and on this basis, an effective evaluation system is established to provide theoretical

support for the effective evaluation of the agricultural product trade supply chain performance between ASEAN and Guangxi, China.

4.2 Select the influencing factor indicators of cross-border agricultural supply chain performance

On the basis of determining the performance evaluation criteria of the supply chain of cross-border trade agricultural products, the performance indicators that can affect the supply chain are analyzed, and the selection basis of the influencing factors indicators is determined through multi-perspective and multi-level evaluation rules. Due to the complementary geographical advantages and resource advantages of China and ASEAN contracting countries, a common platform can be built for agricultural trade. At present, there are ten main objects between Guangxi and ASEAN contracting countries, namely Singapore, Malaysia, Thailand, Indonesia, Brunei, Vietnam, Philippines, Laos, Cambodia and Myanmar [11-14]. Through the further development of the "One Belt, One Road" policy, the trade between Guangxi and ASEAN contract countries in the world has become closer, forming closer economic exchanges, and promoting the trade supply chain to become the product of economic integration, which plays a pivotal role in both Guangxi and ASEAN countries. In order to avoid collinearity of indicators and facilitate subsequent supply chain performance evaluation, indicators are classified according to three levels, as shown in Table 2.

Table 2 Performance assessment indicators of Guangxi-ASEAN cross-border agricultural supply chain

Target layer	Criterion layer	Index layer	type
Performance Evaluation of Guangxi-ASEAN Cross-border Agricultural Products Supply Chain	Logistics index	Inventory loss ratio	negative direction
		Proportion of transportation losses	negative direction
		Agricultural product flexibility	forward direction
		Transport time flexibility	negative direction
		Quantitative flexibility of agricultural products	forward direction
	Operational indicators	Ratio of total assets return	forward direction
		Proportion of consumer complaints	negative direction
		Timely delivery	forward direction
		Delivery accuracy	forward direction
		Proportion of per capita economic growth	forward direction
	Customs clearance index	Customs clearance time	negative direction
		Customs clearance cost	forward direction
		Percentage of customs clearance inspection	negative direction
		Annual customs declaration volume	negative direction
	Cooperative stability index	Changes of partners	negative direction
		Policy transparency	forward direction
		Degree of information sharing	forward direction
		Core competence of cooperation	forward direction

According to the content in the above table, the corresponding performance evaluation indicators are selected according to the division of target layer and criterion layer, and there are a total of 18 groups of indicators. Under different standards, each criterion can reflect the supply chain model of cross-border trade, and can directly reflect the overall trade situation between Guangxi and ASEAN contract countries. First, the logistics index can reflect the logistics development level of cross-border trade, that is, whether it can quickly respond to the demand for agricultural products. The development of logistics in the cross-border trade of agricultural products can affect many

aspects, such as warehousing services, distribution services, transportation services and writing services. Second, the operational indicators are mainly the evaluation of trade funds, such as the financial changes of trade and the delivery of trade. In international trade, both the mode of trade and the driving factors are changing, which constantly affect the trade supply chain, and thus produce different performance of trade supply chain. Third, the customs clearance index can measure the changes in the customs environment of trade, such as the trade activities and contract forms of agricultural products and commodities, and the effect analysis of agricultural products and commodities trade services can be carried out in the overall evaluation [15-18]. Fourthly, information sharing can be analyzed in the cooperation stability index. Whether it is logistics information, capital information or trade information, it may affect the cross-border supply chain of agricultural products. Once the cost of information increases, trade will be difficult; if the degree of information sharing is higher, the transparency of trade will be improved [19]. Through the selection of evaluation indicators and the analysis of influencing factors, the principal component analysis method is selected to build the performance evaluation model, which provides a mathematical model for the performance evaluation of the Guangxi-ASEAN cross-border agricultural product supply chain.

4.3 Build the mathematical model of performance evaluation index

In order to realize the performance evaluation of ASEAN cross-border trade supply chain, it is necessary to analyze and classify the selected indicators based on the management mode of agricultural product supply chain based on the selected evaluation indicators and evaluation criteria, so as to judge the importance of the indicators. Among them, principal component analysis, as an important method in statistics, has been applied in many fields for analysis. This method can connect relevant indicators and classify them according to their importance [20]. The selected indicators of each group were sorted by principal component analysis, their importance was analyzed, and the grading standards were determined, as shown in Table 3.

Table 3 Performance appraisal grade classification standards

serial number	Value range	grade
1	$0.85 \le h \le 1$	very good
2	$0.65 \le h < 0.85$	better
3	$0.45 \le h < 0.65$	common
4	$0.25 \le h < 0.45$	bad
5	$0 \le h < 0.25$	Very bad

According to the content in the table, the principal component analysis method is used to sort the important levels of the indicators as the value range, and the specific evaluation content of the indicators is integrated to divide different evaluation levels. The evaluation indicators are graded according to "very good", "good", "average", "bad" and "very bad". By analyzing each group of evaluation indicators in the way of principal component analysis, the principal components of different indicators can be extracted and sorted, and the importance of indicators can be sorted in each dimension. See Figure 1 for details.

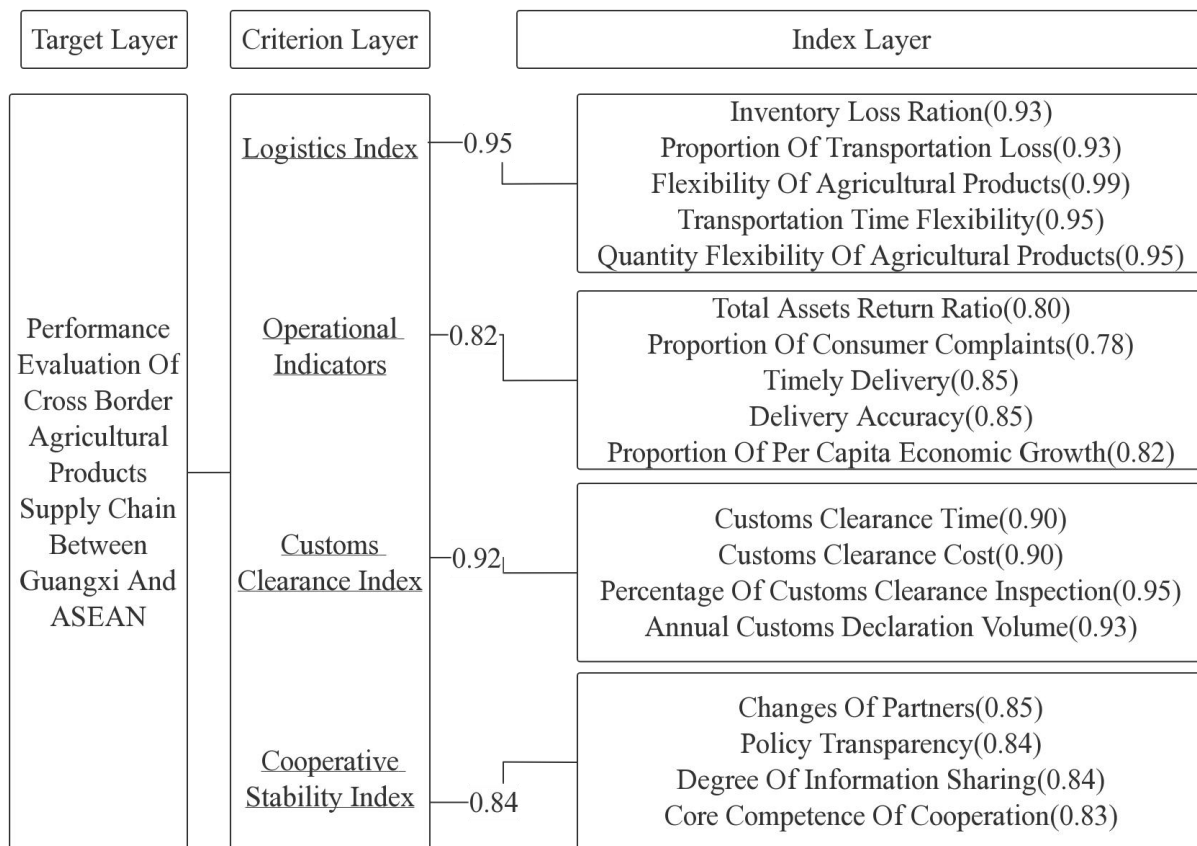| Target Layer	Criterion Layer	Index Layer
Performance Evaluation Of Cross Border Agricultural Products Supply Chain Between Guangxi And ASEAN	Logistics Index —0.95	Inventory Loss Ration(0.93) Proportion Of Transportation Loss(0.93) Flexibility Of Agricultural Products(0.99) Transportation Time Flexibility(0.95) Quantity Flexibility Of Agricultural Products(0.95)
	Operational Indicators —0.82	Total Assets Return Ratio(0.80) Proportion Of Consumer Complaints(0.78) Timely Delivery(0.85) Delivery Accuracy(0.85) Proportion Of Per Capita Economic Growth(0.82)
	Customs Clearance Index —0.92	Customs Clearance Time(0.90) Customs Clearance Cost(0.90) Percentage Of Customs Clearance Inspection(0.95) Annual Customs Declaration Volume(0.93)
	Cooperative Stability Index —0.84	Changes Of Partners(0.85) Policy Transparency(0.84) Degree Of Information Sharing(0.84) Core Competence Of Cooperation(0.83)

Figure 1 Ranking of the importance of performance appraisal indicators

As shown in the figure, the performance evaluation of the Guangxi-ASEAN cross-border agricultural supply chain is the target layer, and the contents of the selected criterion layer and indicator layer are sorted respectively, so as to see the ranking of their importance in the overall performance evaluation, which is displayed as "logistics index" > "customs clearance index" > "cooperation stability index" > "operation index". The importance of the indicators was divided by the principal component analysis method, the selected evaluation indicators were standardized and sorted according to the main components, so as to show the order of the empirical evaluation process of the performance of the Guangxi-ASEAN cross-border agricultural industry supply chain. Based on the principal component analysis method, the performance of ASEAN cross-border agricultural product supply chain is analyzed through the results of division. In the performance evaluation, the grade standards in Table 3 above are still applied, and the supply chain performance is evaluated according to the scores of each index, so as to complete this empirical study.

5. Empirical analysis of the performance of Guangxi-ASEAN cross-border agricultural supply chain

In order to realize the empirical analysis of the performance of the Guangxi-ASEAN cross-border agricultural product supply chain, it is necessary to select data samples without discrimination. This time, the ten contract countries of Singapore, Malaysia, Thailand, Indonesia, Brunei, Vietnam, the Philippines, Laos, Cambodia and Myanmar are taken as objects, and the analysis is carried out according to the overall situation. In the process of empirical analysis, enterprises in the agricultural products trade supply chain were selected. In order to keep the relevant information confidential, the names of enterprises were not disclosed this time, and only the top ten enterprises in Guangxi were taken as corresponding. It is required that all of the 10 enterprises have realized the construction of agricultural trade supply chain with the above contract countries. After the test data is collected, the results are analyzed.

5.1 The modern logistics system is becoming more and more perfect to meet the needs of consumers

This time, the performance evaluation of Guangxi-ASEAN cross-border supply chain puts logistics index in the first place, indicating that logistics occupies an important position in the performance evaluation of cross-border supply chain. Specific items within the logistics index are analyzed respectively, among which, as follows:

(1) Product flexibility index: This index is the most important, which can express the adaptability of agricultural products in the environment, that is, reflect whether agricultural products trade can meet consumer demand.

(2) Time tenderness index: The importance of this index is in the middle, which mainly reflects the efficient transportation capacity of agricultural products in the trade supply chain, that is, whether they can respond quickly to customer needs.

(3) Quantitative flexibility index: When consumer demand for agricultural products cannot be determined, this index can verify the information processing capacity of the supply chain in the process of agricultural product transportation.

(4) Inventory loss and transportation loss: the importance of these two groups of indicators is similar. When the proportion of inventory loss is large or the proportion of transportation loss is large, it will affect the supply chain performance of cross-border trade, and can also reflect the imperfect hardware equipment of the supply chain.

Through the analysis of the importance of the above indicators, the cross-border trade of ASEAN in the past three years is taken as the validation data, and the scores of the data in each index are calculated respectively, so as to verify the logistics development of the cross-border trade supply chain, as shown in Table 4.

Table 4 Results of logistics index evaluation

index	age		
	2020	2021	2022
Product flexibility index	0.61	0.71	0.92
Time flexibility index	0.71	0.82	0.95
Quantitative flexibility index	0.71	0.77	0.95
Transport loss	0.42	0.49	0.75
Inventory loss	0.45	0.52	0.79

As shown in Table 4, in the data analysis results of the past three years, great changes have taken place in the relevant indicators of logistics evaluation in the cross-border trade supply chain of ASEAN. Among them, the ratio of inventory loss and transportation loss is "good", indicating that the hardware equipment of the supply chain is constantly improved, while the quantity flexibility index and time flexibility index are "very good". It shows that ASEAN cross-border trade of agricultural products has high efficiency and timeliness. In view of the above situation, the continuous development of hardware facilities has realized the construction of the logistics system, and the accurate distribution of agricultural products can be realized in a relatively perfect logistics system, so as to fully meet the needs of consumers.

5.2 The quality of cross-border agricultural products has been improved, and the cost and time of customs clearance have been continuously reduced

In the performance evaluation of cross-border trade supply chain, the customs clearance index is placed in the second place, mainly because cross-border trade is closely related to customs clearance, and both the cost and time of customs clearance will affect the development of cross-border trade. Among them, the customs clearance rate is related to the cost of passing the customs clearance and the customs clearance time. When the inspection rate is low, the customs clearance time will be increased, so as to increase the customs clearance cost, and the inspection rate is related to the quality of agricultural products, so the selected indicators are specific. Based on

this, data samples of the past three years are still used to evaluate the above indicators, and the results are shown in Table 5.

Table 5 Evaluation results of customs clearance indicators

index	age		
	2020	2021	2022
Customs clearance time	0.39	0.59	0.79
Customs clearance cost	0.31	0.68	0.86
Percentage of customs clearance inspection	0.45	0.59	0.84
Annual customs declaration volume	0.40	0.59	0.79

Among them, in the data analysis of the past three years, the grades of each group of indicators include "good" and "very good", and the grade of cross-border inspection rate of agricultural products is "good", indicating that the inspection rate is gradually declining, the product quality in the supply chain of agricultural products is high, and the grade is also reflected in the customs clearance time and customs clearance cost indicators are "good". It can account for less customs clearance time and lower costs. The comprehensive inspection rate and customs clearance time and cost can increase the cross-border trade volume in the lower customs clearance cost and time.

5.3 The supply cooperation relationship is gradually stable, which can achieve cross-border win-win of agricultural products

The ultimate goal of agricultural trade with ASEAN contract countries is to achieve cross-border win-win results. For the supply chain performance evaluation of ASEAN agricultural products, the element of cooperation stability is selected in the final index, that is, the main purpose is to verify whether the cross-border trade of ASEAN agricultural products is sustainable through the analysis of various indicators. Among them, the change of partners directly reflects the stability of trade cooperation, while core capabilities can reflect the utilization degree between enterprises, including enterprise equipment and management methods. In addition, the sharing of information and the openness of policies can reflect whether the trade information flow between enterprises can be realized. According to the intrinsic meaning of each group of indicators, the indicators were evaluated, and the results were shown in Table 6.

Table 6 Evaluation results of cooperation stability index

index	age		
	2020	2021	2022
Changes of partners	0.48	0.75	0.96
Policy transparency	0.42	0.72	0.89
Degree of information sharing	0.42	0.72	0.90
Core competence of cooperation	0.56	0.745	0.91

As shown in the table, the data selected in the evaluation of the cooperation stability index are also samples of the past three years. Whether it is the information sharing index, the degree of policy openness and the core competence, the rating is "very good", indicating that the circulation of information is constantly increasing and the policy support is open and transparent. No matter which group of indicators is rated as "very good", it can stabilize the cooperative relationship between the contract countries and make the cross-border trade cooperation have better stability, so as to ensure the sustainable development of the cross-border supply chain of ASEAN agricultural products.

5.4 The delivery of agricultural products will be more timely and accurate, and the profits of supply chain enterprises will be improved

Through the evaluation of logistics indicators in the cross-border trade supply chain, it can be seen that the logistics system is gradually improving at this stage, and on this basis, the operation indicators in the supply chain are analyzed. The selection of operational indicators is based on

logistics. Only a perfect logistics system can ensure the transportation of agricultural products, so as to achieve the timeliness and accuracy of agricultural products delivery. Therefore, in the evaluation of operational indicators, the timeliness and accuracy of delivery are more important. If the above situation is problematic, the satisfaction of consumers will be affected and the total return of the supply chain will be reduced. The specific results are shown in Table 7.

Table 7 Evaluation results of operational indicators

index	age		
	2020	2021	2022
Ratio of total assets return	0.45	0.73	0.97
Proportion of consumer complaints	0.41	0.62	0.78
Timely delivery	0.50	0.78	0.97
Delivery accuracy	0.62	0.78	0.97
Proportion of per capita economic growth	0.71	0.78	0.97

In the above table, in the evaluation of the operational indicators, the data of the past three years is still analyzed, and the delivery and timeliness indicators are both "very good", indicating that the transportation of agricultural products is efficient and fast, and the timeliness and accuracy of the supply chain of agricultural products can be realized. The customer complaint rate index is in the "good" level, indicating that consumer satisfaction has increased, while the total asset return index is in the "very good" level, indicating that the enterprise's income has improved. Based on the above situation, it can be seen that timely and accurate cross-border supply of agricultural products can continuously improve the income of enterprises in the supply chain.

6. Closing remarks

This paper analyzes the concept and management mode of ASEAN cross-border agricultural product supply chain, designs evaluation models according to different indicators, and completes the empirical analysis of the performance of ASEAN cross-border agricultural product supply chain. The development of agricultural product supply chain can be obtained through different index scores, which are mainly reflected in logistics infrastructure construction and cross-border cooperation. With the mature development of logistics infrastructure, the customs clearance time and cost of cross-border trade of agricultural products are gradually reduced, and the quality of agricultural products is constantly improved, thus further improving the cross-border supply chain of ASEAN agricultural products and realizing cooperation between enterprises. To achieve sustainable development of ASEAN cross-border agricultural trade.

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