

The Study on Competitiveness and Complementarity of Fruit Trade between China and ASEAN

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Abstract:

The Regional Comprehensive Economic Partnership (RCEP) has officially entered into force, providing institutional support and exerting a far-reaching impact on the deepening of fruit trade between China and ASEAN. Based on the relevant data from 2019 to 2023 in the UN Comtrade Database, this paper sorts out the current situation of bilateral fruit trade, and adopts the RCA, TC and TCI indices to measure and analyze its competitiveness and complementarity. The empirical results show that the two sides have formed a differentiated pattern in line with their resource endowments: China has a strong advantage in temperate fruits such as apples and pears and some processed fruits, while ASEAN holds an absolute advantage in tropical fruits such as durians and bananas; the complementarity of ASEAN's exports to China is significantly higher than that of China's exports to ASEAN. Meanwhile, it is found that there are problems such as imbalance, single structure and low added value in bilateral trade. Accordingly, this paper puts forward suggestions to address these pain points and promote the high-quality development of bilateral fruit trade, including deepening industrial chain coordination, improving the RCEP trade support system, expanding niche markets by relying on cross-border e-commerce, and jointly building branded processing parks.

Keywords:

China-ASEAN, Fruit Trade, Competitiveness, Complementarity, RCEP

Introduction

The full entry into force and implementation of the Regional Comprehensive Economic Partnership (RCEP) marks the official operation of the world's largest free trade zone. This not only accelerates the process of East Asian regional economic integration, but also injects new impetus into global economic cooperation, exerting a profound and lasting impact on deepening the China-ASEAN economic and trade partnership. Against this backdrop, China-ASEAN fruit trade has demonstrated strong resilience in growth: the total volume of bilateral fruit trade surged from 14.451 billion US dollars in 2019 to 28.448 billion US dollars in 2023, representing a 97% increase over five years. This fully highlights the solid foundation for cooperation and huge development potential between the two sides in the field of fruit trade. To promote the sustained and sound development of China-ASEAN fruit trade, an in-depth analysis of the characteristics of competitiveness and complementarity in bilateral trade, as well as an accurate grasp of development opportunities and challenges, has become an urgent and important issue to be addressed at present.

With the implementation of the RCEP agreement and the deepening of the Belt and Road Initiative, China-ASEAN bilateral fruit trade has become the core of agricultural cooperation. Academic circles have formed a series of studies on the trade pattern, competitiveness, complementarity and development countermeasures. In the research on trade patterns, scholars generally hold that bilateral trade presents a trend of steady growth and concentrated structure: Lei Jindong et al. (2022) and Xu Huijin et al. (2022), through calculations based on data from different periods, all pointed out that Thailand and Vietnam are the core partners of bilateral fruit trade, accounting for more than 60% of the total trade volume in 2019; Ou Xijing et al. (2024) supplemented the dynamics under the background of RCEP, indicating that the total bilateral trade volume exceeded 12 billion US dollars in 2021, with the trade deficit expanding and products concentrated in fresh fruits. Chen Hong et al. (2022) focused on the segmented China-Vietnam market and found that the average annual growth rate of bilateral trade from 2006 to 2020 reached 28.76%, and Vietnam's fruit export volume rose to 1.15 billion US dollars in 2020, making it an important trading partner of China; Liu Huayu et al. (2022) clearly stated that ASEAN accounts for 30% of China's total fruit export volume, showing a significant degree of regional concentration in trade. In terms of competitiveness evaluation, most scholars have conducted research using quantitative indicators: Jin Yan et al. (2022) applied the EF and RCA indices and pointed out that ASEAN has prominent resource endowments in tropical fruits, with the Philippines maintaining a high RCA index for a long time; Xu Huijin et al. (2022) added the TSC and MS indices for calculation and found that China's international fruit competitiveness is weaker than that of ASEAN as a whole; Chen Hong et al. (2022) conducted the most targeted research on China-Vietnam fruit trade, and their RCA index calculation showed that China has comparative advantages in 7 categories of temperate fruits (such as apples and pears) and Vietnam in 2 categories of tropical fruits (coconuts and other fresh fruits). Among them, China's average RCA index for temporarily preserved fruits and nuts (HS0812) reached 7.2, reflecting particularly prominent competitiveness. In the analysis of complementarity, indices such as TCI and TCD have all verified the strong complementary characteristics of bilateral trade: Lei Jindong et al. (2022) pointed out that the bilateral trade links are close; Chen Hong et al. (2022) further found that China-Vietnam fruit trade is dominated by inter-industry trade, the complementarity between China's exports and Vietnam's imports has been continuously enhanced, and temperate and tropical fruits form a positive complementary relationship. Their TCD index calculation also showed that the two countries have close trade links in categories such as citrus fruits. In summary, existing studies have initially outlined the core characteristics of China-ASEAN bilateral fruit trade, but there are still obvious deficiencies: first, the research on segmented categories and countries is not in-depth enough, with most studies focusing on overall trade and failing to conduct differentiated analyses on specific categories under HS codes and disadvantaged countries such as Cambodia and Laos; second, there is a lack of dynamic research on trade characteristics after the entry into force of RCEP, with insufficient analysis of the impact of the dividend from tariff reduction after 2022. Based on this, this paper combines the latest trade data and conducts an in-depth quantitative analysis focusing on segmented fields, aiming to provide support for the high-quality development of bilateral trade. The innovations of this paper are as follows: based on the latest data from 2019 to 2023, focusing on the differences in segmented categories and countries, it constructs a complete analytical framework using three major indices (RCA, TC and TCI), accurately identifies the pain points of bilateral trade, and puts forward targeted and operable optimization suggestions to make up for the shortcomings of existing studies.



Based on data availability and the actual situation of China-ASEAN fruit trade, all the bilateral fruit trade data selected in this paper are sourced from the United Nations Commodity Trade Statistics Database (UN Comtrade), covering edible fruits and related processed products specified in Chapter 8 and Chapter 20 of the Harmonized Commodity Description and Coding System (HS Code) of the World Customs Organization. The specific classification is shown in the table below:

Table 0-1 Codes and Names of Fruit Trade Classified by HS Code Standards

Commodity Code and Name	Commodity Code and Name
0801 Coconuts, Brazil nuts and cashew nuts, fresh or dried	0810 Other fresh fruits
0802 Other nuts, fresh or dried	0811 Frozen fruits and nuts
0803 Bananas, including plantains, fresh or dried	0812 Fruits and nuts, temporarily preserved, not suitable for direct consumption
0804 Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens, fresh or dried	0813 Dried fruits other than those of heading 0801 to 0806; mixed nuts or dried fruits
0805 Citrus fruit, fresh or dried	0814 Peels of citrus fruit or melons (including watermelons)
0806 Grapes, fresh or dried	2001 Vegetables, fruits, nuts and other edible parts of plants
0807 Melons (including watermelons) and papayas, fresh	2006 Vegetables, fruits, nuts, peels and other parts of plants, preserved in sugar
0808 Apples and pears, fresh	2008 Fruits, nuts and other edible parts of plants, not elsewhere specified or included
0809 Apricots, cherries, peaches, plums and sloes, fresh	2009 Fruit juices and vegetable juices, unfermented and not containing added alcohol

1. Current Situation of China-ASEAN Fruit Trade Before and After the Entry into Force of RCEP

The entry into force of the Regional Comprehensive Economic Partnership (RCEP) has injected new impetus into the development of China-ASEAN fruit trade and driven new changes in the pattern of bilateral fruit trade, with its trade development trend becoming an important observation dimension for regional agricultural product trade cooperation. The following is a detailed multi-dimensional analysis to systematically sort out the actual development status of China-ASEAN fruit trade before and after RCEP took effect.

1.1 Analysis of the Overall Scale and Growth Trend of China-ASEAN Fruit Trade

From 2019 to 2023, against the macro backdrop of RCEP's official entry into force, the fruit trade relations between China and ASEAN exhibited the prominent characteristics of a rapid growth in total volume yet an increasingly imbalanced structure. On the one hand, the total bilateral fruit trade volume soared from 14.451 billion US dollars to 28.448 billion US dollars, with a compound annual growth rate (CAGR) of 18.4%, indicating an unprecedented rise in the strategic interdependence of the two sides in each other's trade patterns. On the other hand, trade flows showed a distinct trend of unilateral driving: the robust growth of ASEAN's exports to China stood in sharp contrast to the sluggish stagnation of China's exports to ASEAN, resulting in a continuously expanding trade deficit for China. This trend profoundly reflects the trade complementarity between the two sides based on resource endowments, as well as the uneven distribution of market access dividends brought by the entry into force of RCEP.

1.1.1 China's Fruit Exports to ASEAN Show a Trend of "Peaking and Declining with Lackluster Growth"

As can be seen from the data in Table 1-1, China's fruit export volume to ASEAN over the past five years was not a simple "fluctuating decline", but experienced two phases: impulse growth driven by short-term stimuli and insufficient long-term growth momentum. In 2020, boosted by the positive market expectations from the signing of RCEP, China's fruit exports to ASEAN surged to 5.346 billion US dollars, an increase of 24.5% compared with 2019, and its share in China's global fruit exports also hit a peak of 50.30%. This was mainly due to the boost of the agreement's prospects to customs clearance expectations and trade confidence. After 2021, the export volume declined and stabilized in the range of 4.1 to 4.6 billion US dollars. Following the official entry into force of RCEP in 2022, the dividends from tariff reduction were mainly released for ASEAN's tropical fruit exports to China, while China's traditional advantages in temperate fruits in the ASEAN market failed to be converted into new growth momentum. Its market share (proportion of China's global exports) also fell from 50.30% in 2020 to 40.04% in 2023. Despite the stagnant growth of China's export volume, in terms of total bilateral trade volume, the proportion of China-ASEAN fruit trade volume in China's global fruit trade volume rose from 43.46% to 53.11%. This precisely indicates that the overall focus of China's fruit trade is accelerating its shift towards ASEAN.

Table 1-1 Overview of China's Fruit Trade with ASEAN and the World, 2019-2023 (Unit: USD 100 million)

Year	China's Exports to ASEAN	China's Exports to the World	Share in ASEAN Market	Total China-ASEAN Fruit Trade	Total China-World Fruit Trade	Share of Total Volume
2019	42.96	98.50	43.61%	99.15	228.14	43.46%
2020	53.46	106.29	50.30%	118.65	239.08	49.63%
2021	46.22	102.65	45.03%	140.87	277.39	50.78%
2022	41.31	99.20	41.64%	140.22	282.89	49.57%
2023	41.05	102.51	40.04%	165.55	311.70	53.11%

Source: Calculated and compiled based on UN Comtrade data.

1.1.2 ASEAN's Fruit Exports to China Show a Trend of "Rapid Growth and Deepening Dependence"

In contrast to China's sluggish exports, ASEAN's fruit exports to China have demonstrated strong growth vitality (Table 1-2). The export volume soared from 10.155 billion US dollars in 2019 to 24.343 billion US dollars in 2023, with a year-on-year surge of 47.8% in 2023 in particular, reflecting the strong driving effect of tariff reduction and trade facilitation under the RCEP framework. The proportion of ASEAN's fruit exports to China in its global fruit exports rose sharply from 41.24% to 56.89%, meaning that the Chinese market has absorbed more than half of ASEAN's fruit exports, becoming its absolute core market. This reflects the strong demand in the Chinese market on the one hand, and exposes the potential risk of a highly concentrated export market for ASEAN on the other. The rapid growth of ASEAN's exports to China is the result of the resonance between the institutional dividends of RCEP and the demand from China's consumption upgrading, and it has also strengthened ASEAN's proactive position in bilateral trade.



Table 1-2 Overview of ASEAN's Fruit Trade with China and the World, 2019-2023 (Unit: USD 100 million)

Year	ASEAN's Exports to China	ASEAN's Exports to the World	Share in Chinese Market	Total ASEAN-China Fruit Trade	Total ASEAN-World Fruit Trade	Share of Total Volume
2019	101.55	246.25	41.24%	144.51	353.09	40.93%
2020	111.03	251.07	44.22%	164.49	355.42	46.28%
2021	154.66	302.45	51.14%	200.88	437.89	45.87%
2022	164.76	338.90	48.62%	206.07	500.77	41.15%
2023	243.43	427.87	56.89%	284.48	611.27	46.54%

Source: Calculated and compiled based on UN Comtrade data.

1.1.3 The Growth of Total Bilateral Trade Volume is Accompanied by a Sharp Expansion of Deficit, with Severe Structural Imbalance

The data in Table 1-3 clearly reveals the complete picture of the coexistence of growth and imbalance in bilateral trade. The total bilateral trade volume has maintained growth, but the growth rate is significantly affected by external factors. The growth rate slowed to 2.52% in 2022, which was related to global supply chain disruptions and recurring epidemics; while the high growth rate of 27.56% in 2023 was mainly driven by the aforementioned surge in ASEAN's exports to China. China's trade deficit expanded sharply from 5.859 billion US dollars in 2019 to 20.238 billion US dollars in 2023. The core driver of this change is not the absolute decline in China's exports, but the relative imbalance caused by ASEAN's export growth rate (especially in 2023) being much higher than that of China. The continuous expansion of the deficit directly reflects that ASEAN's competitive advantages in the tropical fruit sector are being acceleratedly realized through RCEP channels, while the export competitiveness of China's temperate fruits is facing a growth bottleneck.

Table 1-3 Scale and Balance of China-ASEAN Bilateral Fruit Trade, 2019-2023 (Unit: USD 100 million)

Year	ASEAN's Exports to China (A)	China's Exports to ASEAN (B)	Trade Balance (B-A)	Total Trade Volume (A+B)	Growth Rate of Total Volume
2019	101.55	42.96	-58.59	144.51	--
2020	111.03	53.46	-57.57	164.49	12.15%
2021	154.66	46.22	-108.44	200.88	18.11%
2022	164.76	41.31	-123.45	206.07	2.52%
2023	243.43	41.05	-202.38	284.48	27.56%

Source: Calculated and compiled based on UN Comtrade data.

1.2 Analysis of Market Share in China-ASEAN Fruit Trade

From 2019 to 2023, China-ASEAN fruit trade exhibited a core-periphery structure, meaning trade was highly concentrated in a small number of hub countries while most remained on the margins of trade. This marked unbalanced distribution not only reflects the resource endowments and industrial advantages of specific countries but also reveals the limitations in market development for both sides. In terms of geographical market layout, bilateral trade faces a high risk of geographical concentration, with its stability overly dependent on the market performance and bilateral relations of individual countries.

1.2.1 China's Export Markets to ASEAN: Dominated by Vietnam, Thailand and Indonesia

China's fruit export destinations in ASEAN are highly concentrated. As shown in Table 1-4, Vietnam, Thailand and Indonesia are China's top three export markets. China's export volume to Vietnam has ranked first in ASEAN for years, reaching a total of 7.719 billion US dollars from 2019 to 2023, accounting for 36.8% of China's total fruit exports to ASEAN in the same period. Although exports declined from their peak after 2020, Vietnam still remained the top destination with 1.364 billion US dollars in exports in 2023. Thailand is China's second-largest export market, with a total export volume of 5.136 billion US dollars over five years, accounting for 24.5%. Exports to Thailand have remained stable since 2020, reflecting the maturity and stability of the market. Indonesia serves as an important supplementary market, with total exports of 3.630 billion US dollars over five years, accounting for 17.3%. By contrast, the Philippines and Malaysia form the secondary markets, with China's exports to both countries ranging from 2.0 to 2.5 billion US dollars over the five-year period. China's fruit exports to Myanmar, Cambodia, Laos and Brunei are negligible, making them frontier markets with development potential. This indicates that the market structure of China's temperate fruit exports has become rigid, with a clear lack of momentum in developing emerging markets.

Table 1-4 China's Fruit Export Volume to ASEAN Countries, 2019-2023 (Unit: USD 100 million)

Year	Vietnam	Myanmar	Malaysia	Indonesia	Thailand	Cambodia	Laos	Philippines	Singapore	Brunei	Total
2019	14.89	2.23	4.32	7.54	8.81	0.06	0.03	4.22	0.83	0.02	42.96
2020	20.26	2.54	4.23	7.62	11.01	0.13	0.06	6.61	1.00	0.02	53.46
2021	16.26	1.18	4.05	7.27	10.23	0.23	0.05	5.65	1.27	0.03	46.22
2022	13.14	0.27	4.59	6.96	11.00	0.20	0.06	3.82	1.22	0.03	41.31
2023	13.64	0.49	4.06	6.91	10.31	0.22	0.06	4.06	1.27	0.02	41.05
Total	77.19	6.71	21.25	36.30	51.36	0.84	0.26	24.36	5.59	0.12	224.00

Source: Calculated and compiled based on UN Comtrade data.

1.2.2 ASEAN's Export Markets to China: Absolute Dominance of Thailand and Rapid Growth of Vietnam

ASEAN's fruit export markets to China show distinct hierarchical differentiation and a significant trend of market concentration, forming an oligopolistic pattern characterized by Thailand as the undisputed leader, Vietnam as the fast-growing pursuer, and other countries as capacity supplements. Thailand is the absolute core of exports: its fruit export volume to China surged from 4.509 billion US dollars in 2019 to 13.044 billion US dollars in 2023, with a five-year total of 44.352 billion US dollars, accounting for 57.2% of ASEAN's total fruit exports to China in the same period. Relying on the strong market appeal of high-quality tropical fruits such as durians and mangosteens, Thailand holds a near-monopolistic position. Vietnam is the most dynamic pursuer: its export volume has grown rapidly since 2021, surging by 119.6% year-on-year to 8.542 billion US dollars in 2023, with a five-year total of 20.126 billion US dollars, accounting for 25.9%. Vietnam has firmly become the second-largest fruit supplier to the Chinese market. Myanmar, the Philippines and Malaysia form the third echelon, with divergent export performances: Myanmar's total fruit exports to China over five years reached 3.433 billion US dollars, accounting for 4.4% of ASEAN's total exports to China. Its export volume fluctuated down from a peak of 1.069 billion US dollars in 2019 to 0.326 billion US dollars in



2022, and rebounded slightly to 0.428 billion US dollars in 2023. Despite certain fluctuations, Myanmar remains an important part of ASEAN's fruit exports to China. The Philippines and Malaysia have relatively stable export volumes, with five-year totals of 3.415 billion US dollars and 1.914 billion US dollars respectively, accounting for a combined share of approximately 6.9%. Notably, although countries such as Indonesia and Cambodia have a small export base, they have achieved exponential growth in recent years. Among them, Cambodia's exports to China rose from 0.029 billion US dollars in 2019 to 0.288 billion US dollars in 2023, showing huge export potential. On the contrary, constrained by their own agricultural resource endowments, Brunei, Singapore and other countries have an extremely small scale of fruit exports to China, with five-year total exports of only 0.00 billion US dollars and 0.067 billion US dollars respectively, having a negligible impact on the overall export pattern.

Table 1-5 ASEAN Countries' Fruit Export Volume to China, 2019-2023 (Unit: USD 100 million)

Year	Vietnam	Myanmar	Malaysia	Indonesia	Thailand	Cambodia	Laos	Philippines	Singapore	Brunei	Total
2019	29.26	10.69	2.15	0.76	45.09	0.29	4.59	8.66	0.04	0.00	101.55
2020	22.81	10.09	2.50	1.07	61.33	1.36	4.73	7.06	0.08	0.00	111.03
2021	24.87	6.01	4.46	1.82	104.26	4.32	2.64	6.11	0.17	0.00	154.66
2022	38.90	3.26	4.38	1.75	102.40	2.72	5.24	5.95	0.16	0.00	164.76
2023	85.42	4.28	5.65	3.92	130.44	2.88	4.26	6.37	0.22	0.00	243.43
Total	201.26	34.33	19.14	9.32	443.52	11.57	21.46	34.15	0.67	0.00	775.42

Source: Calculated and compiled based on UN Comtrade data.

1.2.3 Total Bilateral Trade Volume: Intensified Concentration, with Thailand and Vietnam Accounting for Over 70%

Combining imports and exports, the national distribution of total China-ASEAN fruit trade volume is extremely unbalanced. As shown in Table 1-6: Thailand and Vietnam, the absolute core countries, form the undisputed backbone of China-ASEAN fruit trade. From 2019 to 2023, the total fruit trade volume between Thailand and China reached 49.488 billion US dollars, accounting for 53.09% of the total; the total trade volume between Vietnam and China stood at 21.903 billion US dollars, accounting for 23.50%. The two countries together account for 76.59% of the total bilateral trade volume, demonstrating a feature of "dual-core driving". The secondary participating countries—the Philippines, Indonesia, Myanmar and Malaysia—each have a trade share between 4% and 6%, with a combined share of approximately 20%, forming the secondary participant group in the trade. The total trade volume between China and potential peripheral countries including Cambodia, Laos, Singapore and Brunei is less than 3.5 billion US dollars, with a total share of less than 3.5%. These countries have small market scales on the one hand, but on the other hand, they mean that there is broad growth space and untapped potential for fruit trade between these countries and China.

Table 1-6 Total China-ASEAN Fruit Trade Volume and Market Share by Country, 2019-2023

Ranking	Country	Total Trade Volume (USD 100 million)	Market Share
1	Thailand	49.488	53.09%
2	Vietnam	21.903	23.50%
3	Philippines	58.51	6.28%
4	Indonesia	45.62	4.89%
5	Myanmar	41.04	4.40%
6	Malaysia	40.39	4.33%
7	Laos	13.92	1.49%

8	Cambodia	12.41	1.33%
9	Singapore	6.26	0.67%
10	Brunei	0.12	0.01%
	Total	931.52	100.00%

Source: Calculated and compiled based on UN Comtrade data.

Note: Total trade volume = ASEAN's exports to China + China's exports to ASEAN.

1.3 Analysis of Product Structure in China-ASEAN Fruit Trade

1.3.1 China's Exports to ASEAN: Dominated by Temperate Fruits with a Single Structure and Low Added Value

As shown in Table 1-7, China's fruit exports to ASEAN exhibit a significant feature of product concentration, with temperate fruits occupying an absolute dominant position. Specifically: the core product categories HS 0808 (apples and pears), HS 0805 (citrus fruits) and HS 0806 (grapes) form the three pillars of China's fruit exports to ASEAN, accounting for 29.06%, 20.92% and 17.36% of the export volume respectively, with a combined share of up to 67.34%. This reflects China's traditional advantages in the cultivation and export of temperate fruits. Except for the above three categories, the export share of other fruit categories (such as HS 0801 coconuts and HS 0804 mangoes) is below 3%, and most are primary products. This highly concentrated product structure makes China's fruit exports to ASEAN extremely vulnerable to price fluctuations, changes in market demand or trade barriers for individual categories. Exports are dominated by fresh fruits, with an extremely low share of deep-processed products (such as fruit juices and dried fruits). For example, the combined export share of HS 2006 (sugar-preserved fruits) and HS 2008 (canned fruits) is only 12.63%, indicating that China's fruit exports to ASEAN still remain in a resource export-oriented stage, failing to fully tap the value-added potential of the processing link.

Table 1-7 Share of China's Fruit Export Volume to ASEAN by Product Category, 2019-2023

(Unit: USD 100 million)

HS Code	China's Export Volume to ASEAN	Share	HS Code	China's Export Volume to ASEAN	Share
0801	0.01	0.01%	0811	0.30	0.66%
0802	0.62	1.38%	0812	0.06	0.13%
0803	0.00	0.00%	0813	0.42	0.93%
0804	0.31	0.69%	0814	0.01	0.03%
0805	9.41	20.92%	2001	0.13	0.30%
0806	7.81	17.36%	2006	1.15	2.56%
0807	0.97	2.15%	2007	0.30	0.66%
0808	13.08	29.06%	2008	4.53	10.07%
0809	1.26	2.81%	2009	1.61	3.59%
0810	3.01	6.69%	Total Exports	45.00	--

Source: Calculated and compiled based on UN Comtrade data.



1.3.2 ASEAN's Exports to China: Absolutely Dominated by Tropical Fruits with a High Dependence on Fresh Fruits

As shown in Table 1-8, the product structure of ASEAN's fruit exports to China is also highly concentrated, but in a stark contrast to China: the core product categories HS 0810 (other fresh fruits, such as durians, pitayas, lychees and longans), HS 0803 (bananas), HS 0804 (mangoes, mangosteens, etc.), HS 0811 (dates, figs, pineapples, avocados, guavas) and HS 0801 (coconuts, Brazil nuts, cashew nuts) form the absolute main body of ASEAN's fruit exports to China, accounting for 51.87%, 11.04%, 9.06%, 7.86% and 7.75% of the export volume respectively, with a combined share of up to 87.58%. This fully embodies ASEAN's resource endowment advantages in tropical fruit production. ASEAN's exports to China are dominated by fresh fruits, with an extremely low share of deep-processed products (such as HS 2006 sugar-preserved fruits and HS 2008 canned fruits), accounting for only 4.97% in total. This structure makes ASEAN's fruit exports to China highly vulnerable to shocks from factors such as fresh-keeping technology, transportation losses and price fluctuations, resulting in weak risk resistance capacity. Except for the above core categories, the export share of other fruit categories (such as HS 0805 citrus fruits and HS 0806 grapes) is below 1%, and most are primary products. This highly concentrated product structure makes the stability of ASEAN's fruit exports to China overly dependent on the market performance of a few categories.

Table 1-8 Share of ASEAN's Fruit Export Volume to China by Product Category, 2019-2023

(Unit: USD 100 million)

HS Code	ASEAN's Export Volume to China	Share	HS Code	ASEAN's Export Volume to China	Share
0801	10.55	7.75%	0811	10.70	7.86%
0802	0.46	0.34%	0812	0.13	0.10%
0803	15.03	11.04%	0813	4.38	3.22%
0804	12.34	9.06%	0814	0.31	0.23%
0805	0.44	0.32%	2001	0.05	0.03%
0806	0.01	0.01%	2006	0.82	0.60%
0807	1.73	1.27%	2007	0.23	0.17%
0808	0.00	0.00%	2008	5.95	4.37%
0809	0.05	0.04%	2009	2.34	1.72%
0810	70.59	51.87%	Total Exports	136.10	--

Source: Calculated and compiled based on UN Comtrade data.

1.3.3 China-ASEAN Fruit Trade: Highly Concentrated Product Categories with Strong Complementarity but a Single Structure

Combining the data in Table 1-7 and Table 1-8, the product structure of China-ASEAN fruit trade presents the following characteristics: First, a high degree of product concentration. Both sides' exports are concentrated in a small number of advantageous categories—China mainly exports temperate fruits (HS 0808, HS 0805, HS 0806) while ASEAN focuses on tropical fruits (HS 0810, HS 0803, HS 0804). This concentrated structure makes the stability of bilateral trade vulnerable to market fluctuations of individual categories. Second, strong complementarity but a single structure. The two sides have formed significant trade complementarity through differentiated fruit categories, but this complementarity is based on a single structure of fresh fruits and primary processed products. China's exported temperate fruits have low added value and are easily replaced by

other more cost-effective categories; ASEAN's exported tropical fruits are highly dependent on fresh fruits with a weak deep-processing link. Third, high product concentration implies concentrated market risks. For example, if China's temperate fruit exports to ASEAN encounter price declines or trade barriers, its export volume will be directly impacted; if ASEAN's tropical fruit exports to China suffer increased losses due to inadequate fresh-keeping technology, its market competitiveness will be significantly affected. In addition, the lack of deep-processing links on both sides makes it difficult for bilateral trade to upgrade from "resource complementarity" to "value co-creation".

2. Analysis of the Competitiveness of China-ASEAN Fruit Trade

The preceding section has sorted out the overall status quo, national structure and product category structure of China-ASEAN fruit trade, identifying the core pain points of a single trade structure and low added value on both sides, as well as the differentiated characteristics in product categories and countries. This section will systematically analyze the competitive characteristics of fruit trade between the two sides by applying two major indices—the Revealed Comparative Advantage (RCA) index and the Trade Competitiveness (TC) index—to further verify the pattern of differentiated development.

2.1 Analysis of the Revealed Comparative Advantage (RCA) Index

First proposed by the economist Balassa Bela in 1965, the Revealed Comparative Advantage (RCA) Index is a core indicator for measuring the degree of comparative advantage of a certain industry in a country (or region) in international trade. By comparing the proportion of a certain industry in a country's total export trade with the proportion of the same industry in global total export trade, the index quantitatively reflects the international competitiveness level of the industry in that country. Its specific calculation formula is as follows:

$$RCA_{ai} = \frac{X_{ai}/X_{at}}{X_{wi}/X_{wt}} \quad (2-1)$$

In Formula (2-1), the definitions of each variable are as follows: X_{ai} denotes the export value of product category i from country a ; X_{at} denotes the total export value of all products from country a ; X_{wi} denotes the global export value of product category i ; X_{wt} denotes the global total export value of all products.

The evaluation criteria for the RCA Index are as follows: when the RCA value is greater than 2.5, it indicates that the product category of the country has an extremely strong international competitiveness; when the RCA value is between 1.25 and 2.5 (inclusive), the product category has a strong international competitiveness; when the RCA value is between 0.8 and 1.25 (exclusive), the product category has a moderate international competitiveness; when the RCA value is less than 0.8, the product category has a weak international competitiveness.

Table 2-1 RCA Indices of Fruits for China and the Ten ASEAN Countries, 2019-2023

HS Code	Vietnam	Myanmar	Malaysia	Indonesia	Thailand	Cambodia	Laos	Philippines	Singapore	Brunei	China	ASEAN (10 Countries)
0801	31.40	6.25	0.32	6.13	6.42	11.14	0.89	11.47	0.24	0.00	0.00	12.36
0802	0.42	13.40	0.05	1.44	0.78	0.10	0.35	0.01	0.08	0.00	0.38	2.87
0803	1.51	45.40	0.10	0.07	0.19	14.44	95.48	30.99	0.00	0.00	0.02	48.62
0804	0.99	2.35	0.17	0.66	6.46	2.56	3.69	7.17	0.01	0.01	0.05	4.23
0805	0.30	0.25	0.09	0.01	0.39	0.00	0.79	0.01	0.03	0.00	0.69	0.32
0806	0.01	0.01	0.04	0.00	0.20	0.00	0.34	0.00	0.03	0.00	0.72	0.18
0807	0.79	33.73	0.81	0.01	0.27	0.01	29.06	0.44	0.01	0.27	0.38	18.52



0808	0.00	0.03	0.05	0.00	0.07	0.00	0.03	0.00	0.04	0.00	1.43	0.05
0809	0.01	0.95	0.00	0.00	0.00	0.00	0.08	0.00	0.01	0.00	0.18	0.21
0810	5.26	0.49	0.32	0.03	25.80	0.30	10.50	0.05	0.02	0.00	0.15	12.18
0811	2.07	0.21	4.29	0.20	10.36	0.01	0.18	1.28	0.00	0.00	0.28	4.83
0812	4.35	0.05	0.30	0.02	2.09	3.98	0.98	0.06	0.00	0.00	1.45	2.76
0813	0.62	6.55	0.12	0.47	16.42	0.67	3.85	0.82	0.03	0.00	0.66	5.38
0814	0.05	39.18	0.07	0.01	1.24	0.00	4.86	0.00	0.00	0.00	0.55	12.69
2001	0.99	0.07	0.09	0.01	0.91	0.00	0.28	0.07	0.02	0.00	0.49	0.53
2006	1.44	0.02	0.42	0.01	43.83	87.00	0.00	0.33	0.15	0.00	2.98	38.65
2007	0.43	0.49	0.82	0.40	1.93	0.01	0.01	1.60	0.03	0.00	0.20	0.98
2008	3.51	1.67	0.53	1.76	8.46	1.03	1.11	7.06	0.10	0.01	1.29	4.92
2009	1.20	0.13	0.23	0.45	6.68	0.00	0.03	5.66	0.13	0.00	0.41	3.82
Total	4.89	6.93	0.57	0.82	8.65	7.21	7.82	6.37	0.18	0.05	1.02	6.59

Source: Calculated and compiled based on UN Comtrade data.

Combined with the RCA index calculation results in Table 2-1 and against the aforementioned evaluation criteria for the RCA index, a systematic analysis of the international competitiveness of fruits in China and the ten ASEAN countries leads to the following conclusions:

For China, international competitiveness is observed in only four fruit categories, with advantages concentrated in temperate fruits and some processed fruits, which is highly consistent with China's resource endowment characterized by a predominantly temperate climate. Specifically, first, for HS 0808, the RCA index stands at 1.43, indicating a strong international competitiveness—this is closely linked to China's resource endowment of extensive temperate climate distribution in northern regions and sufficient output of such fruits. Second, HS 0812 has an RCA index of 1.45, also reaching the level of strong international competitiveness. Third, HS 2006 has an RCA index of 2.98 (greater than 2.5), representing an extremely strong international competitiveness. Fourth, HS 2008 has an RCA index of 1.29, falling into the category of strong international competitiveness. In contrast, for typical tropical fruit categories such as HS 0801, HS 0803 and HS 0804, China's RCA indices are all below 0.8, and even zero for some categories, showing an obvious competitive disadvantage. This is highly consistent with China's limited distribution of tropical climate as a resource endowment.

Compared with China, the ten ASEAN countries as a whole demonstrate a more prominent international competitiveness in the fruit sector, with their advantages showing a high degree of agglomeration and focusing on tropical fruit categories, which aligns with the ASEAN region's resource endowment dominated by a tropical climate. Specifically, typical tropical fruit categories including HS 0801, HS 0803, HS 0804, HS 0807 and HS 0810 all exhibit outstanding RCA indices, with the majority of these categories having an RCA index ≥ 1.25 , reaching the level of strong or extremely strong international competitiveness. ASEAN's RCA index for HS 0810 is 12.18, reflecting an extremely strong international competitiveness. At the same time, ASEAN has also shown a certain competitive strength in some processed fruit categories, forming a complement to its advantages in fresh tropical fruits. This has clearly shaped a differentiated competitive advantage pattern of "fresh tropical fruits as the mainstay and processed fruits as the supplement", further consolidating its core position in the global tropical fruit trade.

From the perspective of specific countries, the fruit competitiveness of ASEAN countries presents obvious differentiated characteristics across categories, forming unique competitive advantages for each country: Laos, Myanmar and the Philippines possess an extremely strong competitiveness in HS 0803, with Laos having an RCA index as high as 95.48, Myanmar 45.40 and the Philippines 30.99—all far exceeding the critical value of 2.5 for extremely strong competitiveness. Myanmar has formed a near-monopolistic competitive advantage in HS 0814, with an RCA index of 39.18. Vietnam, Cambodia and the Philippines show strong competitiveness in HS 0801, with RCA indices of 31.40, 11.14 and 11.47 respectively. The Philippines

and Thailand have prominent advantages in HS 0804, with RCA indices of 7.17 and 6.46 respectively. Laos and Myanmar have an extremely strong competitiveness in HS 0807, with RCA indices of 29.06 and 33.73 respectively. Thailand boasts an exceptionally strong competitiveness in HS 0810 and HS 2006, with RCA indices reaching 25.80 and 43.83 respectively. Cambodia's RCA index for HS 2006 hits 87.00, ranking first among all ASEAN countries in terms of competitiveness and making it the core exporting country for this category.

2.2 Analysis of the Trade Competitiveness (TC) Index

The Trade Competitiveness (TC) Index, also known as the Net Export Ratio Index, is a key indicator for measuring the export competitiveness of specific commodities of a country (or region) in bilateral trade. Its core advantage lies in its ability to directly reflect the net export trend of specific commodities and accurately embody a country's trade competitive position in such categories. Complementary to the RCA Index, which focuses on international competitiveness, it jointly improves the competitiveness analysis system.

The specific calculation formula for the Trade Competitiveness (TC) Index is as follows:

$$TC_{ab} = \frac{E_{ab} - I_{ab}}{I_{ab} + E_{ab}} \quad (2-2)$$

In Formula (2-2), the definitions of each variable are as follows: I_{ab} denotes the import value of fruit category b in region (country) a; E_{ab} denotes the export value of fruit category b in region (country) a. The index ranges from -1 to 1, with the specific evaluation criteria as follows: if $0.8 \leq TC < 1$, the category has an extremely strong competitive advantage; if $0.5 \leq TC < 0.8$, it has a strong competitive advantage; if $0 \leq TC < 0.5$, it has a marginal competitive advantage; if $-0.5 \leq TC < 0$, it has a marginal competitive disadvantage; if $-0.8 \leq TC < -0.5$, it has an obvious competitive disadvantage; if $-1 \leq TC < -0.8$, it has an extremely strong competitive disadvantage.

Table 2-2 Comparison of TC Indices in China-ASEAN Bilateral Fruit Trade

HS Code	Vietnam	Myanmar	Malaysia	Indonesia	Thailand	Cambodia	Laos	Philippines	Singapore	China	ASEAN (10 Countries)
0801	1.00	1.00	0.89	1.00	1.00	1.00	0.99	1.00	1.00	-1.00	0.98
0802	-0.11	1.00	-0.70	0.87	-0.60	-1.00	0.98	-1.00	-0.90	0.42	0.15
0803	1.00	1.00	-1.00	1.00	0.98	1.00	1.00	1.00	-1.00	-1.00	0.97
0804	0.98	0.99	-0.84	1.00	1.00	1.00	1.00	1.00	-1.00	-0.93	0.96
0805	-0.95	-0.92	-1.00	-1.00	-0.56	-0.97	0.64	-1.00	-1.00	0.92	-0.75
0806	-1.00	-0.97	-0.96	-1.00	-1.00	-1.00	-0.96	-1.00	-1.00	1.00	-0.98
0807	0.67	1.00	-1.00	1.00	-0.98	-1.00	1.00	1.00	-1.00	0.64	0.62
0808	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	1.00	-1.00
0809	-1.00	1.00	-1.00	-1.00	-1.00	-1.00	0.48	-1.00	-1.00	1.00	-0.32
0810	0.98	0.95	-0.96	-0.95	0.98	0.93	0.99	-0.58	-1.00	-0.88	0.68
0811	0.26	0.26	0.97	-0.90	0.90	-1.00	-1.00	-0.64	-0.96	-0.90	0.12
0812	1.00	--	-1.00	--	-0.93	1.00	1.00	-1.00	-1.00	-0.42	0.45
0813	0.11	1.00	-0.99	-0.95	0.94	0.93	1.00	-0.14	-1.00	-0.63	0.38
0814	-0.66	1.00	-0.99	-1.00	-0.15	--	1.00	--	-1.00	0.47	0.29
2001	0.82	0.97	-1.00	-0.99	-0.46	-1.00	--	-1.00	-1.00	0.54	0.17
2006	0.92	-1.00	-0.99	-1.00	-0.27	1.00	--	-0.38	-1.00	0.29	0.25
2007	-0.55	0.57	0.09	-0.15	0.22	-0.97	-1.00	-0.08	-0.57	0.49	-0.11
2008	0.84	0.73	-0.60	-0.29	0.24	0.00	0.74	-0.93	-0.93	0.11	0.36
2009	0.85	-0.97	0.43	-0.50	0.80	-1.00	-0.94	0.70	0.40	0.03	0.39
Total	0.15	0.80	0.78	0.05	0.65	0.70	0.68	0.75	0.62	-0.90	0.72

Source: Calculated and compiled based on UN Comtrade data.

Note: "--" indicates that the corresponding index value cannot be displayed due to an extremely small data volume.

As can be seen from Table 2-2, the TC Indices of China-ASEAN bilateral fruit trade show distinct regional



and product-specific differentiated distribution characteristics, which are highly consistent with the differences in resource endowments between the two sides and further confirm the analysis conclusions of the RCA Index mentioned earlier.

For China, the competitiveness of its fruit trade presents a distinct feature of "strength in temperate fruits and weakness in tropical fruits", which is highly consistent with the conclusions of the aforementioned RCA Index analysis. China's TC Indices for three temperate fruit categories (HS 0806, HS 0808 and HS 0809) all stand at 1.00, falling within the range of $0.8 \leq TC < 1$, indicating an extremely strong competitive advantage. This is highly aligned with China's resource endowment of extensive temperate climate distribution and sufficient output of such fruits. The TC Index for HS 0805 is 0.92, also belonging to the category of extremely strong competitive advantage, which further confirms China's export competitiveness in the field of temperate fruits. In addition, the TC Indices for categories such as HS 0802, HS 0807, HS 0814, HS 2001, HS 2007, HS 2008 and HS 2009 are all positive, indicating that China also has varying degrees of competitive advantages in these categories. Among them, the TC Index for HS 2001 is 0.54, falling within the range of $0.5 \leq TC < 0.8$, representing a strong competitive advantage. In contrast, China's TC Indices for typical tropical fruit categories are mostly negative, showing obvious competitive disadvantages: the TC Indices for HS 0801 and HS 0803 are both -1.00, falling within the range of $-1 \leq TC < -0.8$, indicating an extremely strong competitive disadvantage; the TC Indices for HS 0804, HS 0810 and HS 0811 are -0.93, -0.88 and -0.90 respectively, falling within the range of $-0.8 \leq TC < -0.5$, representing an obvious competitive disadvantage. This indicates that China is highly dependent on imports for these tropical fruit categories, which is consistent with China's resource endowment characterized by limited distribution of tropical climates.

For the ten ASEAN countries, relying on their resource endowments dominated by tropical climates, they have demonstrated remarkable trade competitive advantages in the field of tropical fruits, and the competitiveness of each country shows obvious product-specific differentiated characteristics, echoing the country-specific differentiated advantages revealed by the RCA Index earlier. Among them, Vietnam, Myanmar, Indonesia, Thailand, Cambodia, Laos and the Philippines have outstanding TC Indices in most tropical fruit categories. The TC Indices for typical tropical fruit categories such as HS 0801, HS 0803 and HS 0804 are mostly 1.00, indicating an extremely strong competitive advantage, which highlights the core position of these countries in the export of tropical fruits such as coconuts, bananas, dates and mangoes.

From a country-specific perspective, Vietnam's TC Indices for HS 0801, HS 0803, HS 0804, HS 0810 and HS 0812 all stand at 1.00, with its competitiveness covering a variety of fresh tropical fruits and some processed fruits, reflecting a comprehensive advantage. Myanmar's competitive advantages are concentrated in categories such as HS 0801, HS 0803, HS 0804, HS 0807, HS 0809, HS 0813 and HS 0814, with a TC Index of 1.00 for all, showing prominent competitiveness in fresh tropical fruits and processed fruit peel categories. Indonesia's advantages are mainly reflected in fresh tropical fruit categories such as HS 0801, HS 0803, HS 0804 and HS 0807, with a TC Index of 1.00 for all, while its competitiveness in processed fruit categories is relatively weak. Thailand's TC Indices for fresh tropical fruit categories such as HS 0801, HS 0804 and HS 0810 are 1.00, and it also has a strong competitive advantage in categories such as HS 0811 and HS 2009, with a relatively balanced category coverage. However, its TC Indices for HS 0802, HS 0805 and HS 0806 are negative, showing certain disadvantages. Cambodia's TC Indices for HS 0801, HS 0803, HS 0804, HS

0812 and HS 2006 all stand at 1.00, with significant advantages in fresh tropical fruits and sugar-preserved processed fruits. Laos' TC Indices for HS 0801, HS 0803, HS 0804, HS 0807, HS 0810, HS 0812, HS 0813 and HS 0814 are all 1.00, with competitive advantages covering a variety of tropical fruit categories. The Philippines' TC Indices for fresh tropical fruit categories such as HS 0801, HS 0803, HS 0804 and HS 0807 are 1.00, and it also has certain advantages in categories such as HS 2008 and HS 2009. Malaysia, Singapore and Brunei show obvious differences in fruit trade competitiveness from other ASEAN countries: Malaysia has an extremely strong competitive advantage only in HS 0801 (TC Index 0.89) and HS 0811 (TC Index 0.97), with negative TC Indices in most other fruit categories, reflecting a large disparity in competitiveness across categories. Singapore and Brunei have negative TC Indices for most fruit categories; Singapore has a positive TC Index only in HS 2009 (0.40), and Brunei has a relatively mild disadvantage only in HS 0807 (TC Index -0.77). The two countries are mainly dependent on imports for fruit trade, with generally weak export competitiveness.

Overall, the analysis of the TC Indices of fruit trade between China and the ten ASEAN countries further confirms the competitiveness differences and complementarity between the two sides: China's competitive advantages are concentrated in temperate fruits and some processed fruits, while the ten ASEAN countries' advantages lie in tropical fruits and some processed fruits. The disadvantaged categories of one side highly align with the advantageous categories of the other, laying a solid foundation for in-depth cooperation in bilateral fruit trade.

3. Analysis of Complementarity in China-ASEAN Fruit Trade

The competitiveness analysis shows that the competition in China-ASEAN fruit trade is weak. Relying on their respective resource endowments, the two sides have formed a differentiated trade pattern with no direct head-on competition. On this basis, this paper will use the Trade Complementarity Index (TCI) to systematically analyze the complementary characteristics of fruit trade between the two sides from the perspective of bilateral trade and explore the potential for two-way trade.

The Trade Complementarity Index (TCI) is mainly used to measure the matching degree between the export advantage of one party and the import demand of the other in the trade of specific commodities between two countries (or regions). It can directly reflect the strength of bilateral trade complementarity, and forms a synergy with the RCA Index and TC Index to construct a complete "competitiveness-complementarity" analysis framework.

The specific calculation formula for the Trade Complementarity Index (TCI) is as follows:

$$TCI_{abi} = RCA_{ai} \times RCDA_{bi} = \frac{X_{ai}/X_{at}}{X_{wi}/X_{wt}} \times \frac{M_{bi}/M_{bt}}{M_{wi}/M_{wt}} \quad (3-1)$$

In Formula (3-1): TCI_{abi} refers to the trade complementarity index of product i between Country a and Country b ; RCA_{ai} denotes the revealed comparative advantage index of product i in Country a ; $RCDA_{bi}$ represents the revealed comparative disadvantage index of product i in Country b ; X_{ai} and X_{at} are the export value of product i and the total export value of all products in Country a respectively; X_{wi} and X_{wt} are the

global export value of product i and the global total export value of all products respectively; M_{bi} and M_{bt} are the import value of product i and the total import value of all products in Country b respectively; M_{wi} and M_{wt} are the global import value of product i and the global total import value of all products respectively. When $0 < TCI_{abi} < 1$, it indicates weak trade complementarity between Country a and Country b ; when $TCI_{abi} \geq 1$, the bilateral trade complementarity is relatively strong, and the larger the value of TCI_{abi} , the stronger the industrial trade complementarity.

Table 3-1 TCI of ASEAN's Fruit Exports to China by Category

HS Code	Vietnam	Myanmar	Malaysia	Indonesia	Thailand	Cambodia	Laos	Philippines	Singapore	Brunei	Average
0801	24.93	4.96	0.25	4.86	5.10	8.84	0.71	9.10	0.19	0.00	5.89
0802	0.49	15.52	0.06	1.67	0.91	0.11	0.40	0.01	0.09	0.00	1.93
0803	1.08	32.54	0.07	0.05	0.14	10.35	68.44	22.21	0.00	0.00	13.49
0804	0.66	1.56	0.12	0.44	4.30	1.71	2.46	4.77	0.01	0.00	1.60
0805	0.10	0.08	0.03	0.00	0.13	0.00	0.25	0.00	0.01	0.00	0.06
0806	0.00	0.00	0.02	0.00	0.10	0.00	0.17	0.00	0.02	0.00	0.03
0807	0.05	2.15	0.05	0.00	0.02	0.00	1.85	0.03	0.00	0.02	0.42
0808	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
0809	0.02	3.14	0.02	0.00	0.01	0.00	0.27	0.00	0.04	0.00	0.35
0810	13.87	1.29	0.84	0.07	67.98	0.79	27.67	0.13	0.05	0.00	11.27
0811	2.45	0.25	5.09	0.24	12.27	0.02	0.21	1.52	0.00	0.00	2.21
0812	3.48	0.04	0.24	0.02	1.67	3.19	0.78	0.05	0.00	0.00	0.95
0813	0.63	6.69	0.12	0.48	16.78	0.69	3.93	0.84	0.03	0.00	3.02
0814	0.01	66.96	0.01	0.00	0.21	0.00	0.83	0.00	0.00	0.00	6.80
2001	0.07	0.01	0.01	0.00	0.07	0.00	0.02	0.00	0.00	0.00	0.02
2006	3.72	0.04	1.08	0.02	113.47	225.23	0.00	0.85	0.40	0.01	34.48
2007	0.11	0.13	0.22	0.11	0.52	0.00	0.00	0.43	0.01	0.00	0.15
2008	2.01	0.96	0.30	1.00	4.84	0.59	0.63	4.04	0.05	0.00	1.44
2009	0.47	0.05	0.09	0.17	2.59	0.00	0.01	2.20	0.05	0.00	0.56
Average	2.85	7.18	0.45	0.48	12.16	13.24	5.72	2.43	0.05	0.00	4.46

Source: Calculated and compiled based on UN Comtrade data.

An analysis of Table 3-1 reveals that in ASEAN's fruit exports to China, the TCI varies greatly among different ASEAN countries due to differences in natural conditions such as climate and soil. Thailand and Cambodia have an average TCI of over 10, reaching 12.16 and 13.24 respectively, indicating a fairly high degree of complementarity between these two countries in fruit exports to China. Next, Myanmar, Laos, Vietnam and the Philippines have an average TCI of 7.18, 5.72, 2.85 and 2.43 in that order, meaning these four countries also have a certain degree of complementarity in fruit exports to China. However, Brunei, Singapore, Indonesia and Malaysia all have an average TCI below 1, which shows that Brunei and Laos have extremely weak trade complementarity with China in fruit export trade. Overall, the trade situation of ASEAN countries in terms of complementarity in fruit exports to China is uneven. Thailand, Cambodia, Myanmar, Laos, Vietnam and the Philippines are the main export forces, while the other countries have relatively weak export competitiveness. This indicates that China's fruit imports from ASEAN are largely dependent on a few ASEAN countries.

From the perspective of the average TCI of different fruit categories, the TCI values of HS 2006, HS 0803 and HS 0810 are all above 10, indicating an extremely strong trade complementarity for these three fruit categories. Followed by HS 0814, HS 0801, HS 0813, HS 0802, HS 0804, HS 0811 and HS 2008, all with a TCI greater than 1, which means these categories have a strong trade complementarity in China-ASEAN fruit trade. The TCI of the remaining categories fluctuates between 0 and 1, showing that there is little difference in the trade complementarity of these fruits exported by ASEAN countries to China, and the overall level is relatively stable with extremely poor trade complementarity in their fruit exports to China.

From the perspective of countries and fruit categories, there are significant regional differences in ASEAN's

fruit exports to China. Laos, Myanmar and the Philippines have a significantly higher TCI for HS 0803 (bananas), reaching 68.44, 32.54 and 22.21 respectively. Thailand and Cambodia have an extremely high TCI for HS 2006 (sugar-preserved fruits and the like), at 113.47 and 225.23 respectively, which reflects the strong competitiveness of these two countries in the processed fruit sector. Vietnam and Thailand have a relatively significant complementarity in exporting HS 0801 (coconuts and cashew nuts) to China. The results show that ASEAN has an obvious complementarity with China in the export of many tropical fruits including bananas, coconuts, Brazil nuts and cashew nuts.

Table 3-2 TCI of China's Fruit Exports to ASEAN by Category

HS Code	Vietnam	Myanmar	Malaysia	Indonesia	Thailand	Cambodia	Laos	Philippines	Singapore	Brunei	Average
0801	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0802	0.49	0.00	0.24	0.06	0.43	0.01	0.21	0.03	0.07	0.02	0.16
0803	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
0804	0.01	0.00	0.05	0.03	0.01	0.00	0.11	0.00	0.01	0.14	0.04
0805	0.26	1.50	1.47	1.24	0.74	0.16	0.74	1.18	0.21	1.56	0.91
0806	0.77	0.37	1.16	2.84	2.07	0.10	0.28	1.42	0.20	0.90	1.01
0807	0.06	0.00	0.12	0.00	0.09	0.00	0.05	0.00	0.19	2.74	0.33
0808	2.81	5.04	4.05	11.07	7.16	0.54	0.50	6.26	0.64	3.50	4.16
0809	0.08	0.01	0.08	0.03	0.09	0.03	0.04	0.00	0.04	0.05	0.04
0810	0.06	0.06	0.10	0.11	0.09	0.03	1.19	0.02	0.05	0.45	0.22
0811	0.03	0.01	0.05	0.03	0.67	0.02	0.00	0.06	0.02	0.02	0.09
0812	0.02	0.11	0.37	0.04	8.95	0.04	2.29	4.05	0.07	13.99	2.99
0813	0.69	0.02	1.14	0.09	0.69	0.06	4.62	0.08	0.17	1.76	0.93
0814	0.13	0.07	0.91	0.06	0.56	0.00	0.01	0.02	0.05	0.75	0.26
2001	0.03	0.06	0.12	0.03	0.12	0.03	0.01	0.08	0.08	0.34	0.09
2006	1.27	1.28	16.50	1.83	25.23	1.95	0.34	2.00	3.39	1.98	5.58
2007	0.04	0.15	0.27	0.21	0.09	0.17	0.07	0.15	0.05	0.25	0.15
2008	0.44	0.49	1.80	0.57	1.37	0.31	0.12	0.57	0.45	2.71	0.88
2009	0.06	0.19	0.20	0.10	0.26	0.09	0.40	0.16	0.11	0.30	0.19
Average	0.38	0.49	1.51	0.97	2.56	0.19	0.58	0.85	0.31	1.66	0.95

Source: Calculated and compiled based on UN Comtrade data.

It can be found from Table 3-2 that when China is regarded as the exporting country and ASEAN as the importing country to calculate the TCI, there are obvious differences in the trade complementarity of China's fruit export trade with various ASEAN countries. In terms of the average value, Thailand, Brunei and Malaysia all have a TCI greater than 1, which means China's fruit exports to these countries have relatively strong complementary characteristics. Among them, Thailand has the highest average TCI of 2.56, followed by Brunei with a value of 1.66. The TCI of China's fruit exports to ASEAN fluctuates within a relatively narrow range, from 0.19 to 2.6, which indicates that the complementarity of China's fruit export trade to ASEAN is not particularly significant.

In terms of the average TCI of different fruit categories, the TCI of four fruit categories (HS 0806, HS 0808, HS 2006 and HS 0812) are generally greater than 1, a value that indicates a relatively high trade complementarity for these fruits. Among these categories, HS 2006 (sugar-preserved fruits, nuts and fruit peels) has the highest TCI of 5.58, followed by HS 0808 (temperate fruits including apples and pears) with a TCI of 4.16, HS 0812 (temporarily preserved fruits and nuts) with a TCI of 2.99, and HS 0806 (grapes) with a TCI of 1.01. This is mainly because all ASEAN countries are located in tropical regions, and their climatic conditions limit the cultivation capacity of temperate fruits such as apples and grapes. In addition, there is a large Chinese population in this region and it is geographically close to China, resulting in a relatively high demand for temperate fruits such as apples, pears and grapes in this area.

It can be seen from Table 3-1 and Table 3-2 that the average TCI of ASEAN's fruit exports to China reaches 4.46, which is significantly higher than the average TCI of 0.95 for China's fruit exports to ASEAN. Obvi-

ously, the overall trade complementarity of ASEAN's fruit exports to China is stronger. In bilateral fruit trade, ASEAN fruits have stronger complementarity in the Chinese market, with greater market demand and competitiveness.

4. Conclusions and Recommendations

Through the systematic measurement and analysis of three major indices—the RCA, TC and TCI—this paper clarifies the core characteristics of competitiveness and complementarity in China-ASEAN fruit trade. Combined with the core pain points in the current trade situation, the following sections summarize the key conclusions of this paper and put forward targeted optimization suggestions to promote the high-quality development of bilateral fruit trade.

4.1 Conclusions

Based on the 2019–2023 China-ASEAN fruit trade data from the UN Comtrade database, this paper systematically analyzes the competitive and complementary characteristics of bilateral fruit trade using the RCA, TC and TCI indices. Integrating the differences in resource endowments between the two sides, the core conclusions are drawn as follows:

4.1.1 Weak competitiveness in bilateral fruit trade, forming a pattern of differentiated development

Competitiveness in China-ASEAN bilateral fruit trade is weak, with a differentiated development pattern aligned with their respective resource endowments. Analysis of the latest data and product category classification shows that there is no direct head-on competition in bilateral fruit trade. Calculations of the RCA and TC indices indicate that China's competitive advantages are concentrated in temperate fruits and some processed fruits, with notable competitiveness in HS 0805 (citrus fruits), HS 0808 (apples and pears) and HS 2006 (sugar-preserved fruits)—a feature highly consistent with China's temperate climatic characteristics. In contrast, the ten ASEAN countries boast prominent advantages in tropical fruits: except for Singapore and Brunei, which are major fruit importers, the other eight ASEAN countries possess extremely strong competitiveness in HS 0801 (coconuts) and HS 0803 (bananas), resulting in significant differences in export categories between China and ASEAN and the absence of head-on competition. In addition, there is a clear polarization of competitiveness within ASEAN, and China has a high import dependence on most tropical fruits. Bilateral fruit exports are dominated by primary fresh fruits, with a low proportion of deep-processed products, leaving substantial room for improving the added value of the industrial chain.

4.1.2 Extremely strong complementarity in bilateral fruit trade, with significant potential for two-way trade

Certain fruit categories in China-ASEAN bilateral trade exhibit extremely strong complementarity, offering enormous potential for the development of two-way trade. Driven by differences in geography, climate and resource endowments, the fruit categories of the two sides are naturally complementary—a characteristic verified by the TCI indices, with the complementarity of ASEAN's fruit exports to China being stronger than

that of China's fruit exports to ASEAN. At the national level, such complementarity is mainly concentrated in Thailand, Cambodia, Myanmar and Laos. Among them, Cambodia's HS 2006 (sugar-preserved fruits) and Thailand's HS 0810 (other fresh fruits) record exceptionally high TCI indices, representing particularly prominent complementarity. At the product category level, a distinct "temperate-tropical" corresponding feature is observed: China's complementary advantageous categories are temperate fresh fruits and some processed fruits, while ASEAN's are typical tropical fruits, forming a stable complementary pattern of "ASEAN exporting tropical fruits and China exporting temperate fruits". Overall, China-ASEAN fruit trade features a high degree of compatibility, and relying on the existing characteristics of competition and complementarity, bilateral trade holds great potential for diversified and high-quality development.

4.2 Recommendations

Based on the aforementioned conclusions and the core characteristics of China-ASEAN fruit trade—weak competitiveness and strong complementarity—this paper focuses on industrial chain upgrading, improved trade facilitation and bilateral coordinated development, and puts forward the following targeted suggestions to advance the high-quality and sustainable development of bilateral fruit trade.

4.2.1 Deepen the coordinated upgrading of the industrial chain to address the shortcoming of low added value

Priority should be given to raising the level of intensive processing of temperate fruits, introducing advanced processing technologies and equipment, developing organic cultivation and brand-oriented operations, expanding the export of characteristic categories such as kiwifruit and blueberries, and optimizing the export structure. Meanwhile, Chinese enterprises should be encouraged to cooperate with local agricultural entities in ASEAN, and invest in building branded fruit processing parks in major tropical fruit producing areas such as Thailand and Vietnam. These parks will integrate the entire industrial chain resources of planting, processing, packaging and warehousing, develop deep-processed products such as fruit juice, dried fruit and preserved fruit, and create a China-ASEAN Joint Fruit Brand. Product formulas should be optimized in light of the consumer demand of both sides to effectively improve product added value and drive local employment and industrial upgrading. ASEAN countries should leverage regional cooperation mechanisms to integrate resources and carry out division of labor and collaboration. By drawing on the industrial advantages of Thailand and Vietnam, they can drive Cambodia, Laos and other countries to improve cold chain logistics and standardized production capacity, simultaneously address the issue of export homogenization, and realize the overall upgrading of the regional industrial chain.

4.2.2 Leverage the RCEP framework to improve the bilateral trade support system and consolidate the achievements in trade facilitation

The two sides should jointly establish a mutual recognition system for fruit quality standards, negotiate and formulate grading and pesticide residue standards for major categories such as durian, banana and citrus, learn from the experience of mutual recognition of 57 agricultural product inspection standards between China and Thailand, and introduce blockchain technology to achieve full-process traceability, thus breaking through technical trade barriers. Collaboration between customs, inspection and quarantine departments should be



strengthened to further advance the mechanism of "one declaration, one inspection, one release" and consolidate the current achievements in improving customs clearance efficiency—at present, the average customs clearance time for imported fruits between the two sides has been reduced from 72 hours to 48 hours. Joint efforts should be made to increase investment in cross-border logistics infrastructure, with a focus on improving modern fruit logistics parks and cold chain centers in core distribution hubs such as Guangxi, optimizing the transportation routes of the New Western Land-Sea Corridor, controlling the cold chain cargo damage rate below 8%, improving logistics efficiency and ensuring the quality of fruit transportation. This will lay a solid foundation for addressing the problem of a single trade structure.

4.2.3 Strengthen bilateral coordinated cooperation to expand trade development space and tackle the issue of a single trade structure

To address the problems of "a single trade structure and high market dependence"—namely, the concentration of products in fresh fruits and trade reliance on core countries such as Thailand and Vietnam—China and ASEAN should strengthen agricultural technological cooperation, promote advanced planting technologies such as precision irrigation and green prevention and control of diseases and pests, jointly cultivate fine varieties, and improve fruit yield and quality. A trade matching platform should be actively built to organize enterprises to participate in international fruit exhibitions and trade fairs. Meanwhile, relying on the RCEP trade facilitation policies, an exclusive cross-border e-commerce platform for China-ASEAN fruits should be established, with a focus on exploring niche tropical fruit categories in ASEAN such as wax apple, salak and rambutan. The model of "direct from origin + live stream sales" should be adopted to expand China's sinking markets, and promote the entry of China's characteristic temperate fruits such as kiwifruit and blueberries into ASEAN's niche markets through cross-border e-commerce, so as to develop diversified sales channels and reduce trade dependence on a small number of countries. The cooperative model of "order-based fruit farming" should be further advanced, and cross-border e-commerce platforms and fruit processing parks should be jointly built. This will drive the transformation of bilateral trade from primary fresh fruit trade to the integration of the entire "planting-processing-sales" industrial chain, realizing mutual benefit and win-win results.

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