A Comparative Study on the Impact of Transportation Mode Selection on the Competitiveness of Thailand's Export Fruit Market to China

Yixuan Jiang[1*], and Songwut Deechongkit[2]

Master of Science in Management of Logistics, Rangsit University, Thailand

[*]*Corresponding author.* E-mail: Jiangyixuan404@gmail.com[1*]

Received April 16, 2025; **Revised** May 25, 2025; **Accepted** June 15, 2025

Abstract

This paper conducts a comprehensive comparative analysis, focusing on the transportation of fruits from Thailand to China, to evaluate the impact of different transportation modes—sea, land, and air—on the competitiveness of Thailand's fruit export market. The study employs a mixed-method research approach, combining quantitative analysis of export statistics (e.g., 2023 China import data showing Thailand accounts for 62.8% of major fruit imports) and logistics reports with qualitative in-depth interviews of 15+ key industry stakeholders (Thai exporters, Chinese importers, logistics managers, and government officials). The findings indicate that sea transport, accounting for approximately 51% of total exports, has an average transit time of 4–10 days but suffers a 5% daily spoilage rate for mangoes; land transport offers 2–7 days transit but experiences 2–3 hours border delays due to customs procedures; air transport ensures 6-hour delivery but costs 10 times more than sea transport. Strategic recommendations include constructing an integrated multimodal logistics framework with IoT-enabled cold chain systems and enhancing cross-border processes through Sino-Thai policy coordination. The comparative analysis offers empirical guidance for exporters to strike a balance between cost efficiency and freshness, thereby contributing to both academic research and industry practice.

Keywords: transportation mode selection; export competitiveness; cost-efficiency; cold chain logistics; multimodal integration

Introduction

The rapid progress of globalization and economic development has significantly altered the international trade landscape, underscoring the importance of efficient logistics strategies in the export process, particularly for perishable goods such as fruits. Thailand, as a major supplier of tropical fruits to China, exports over 706,000 tons of fruits to China annually (2023 data), with durian alone contributing hundreds of millions of USD in export value. However, the perishable nature of fruits imposes strict requirements on transit time and temperature control, posing challenges to logistics efficiency. For instance, sea-transported durians face a 4 to 10-day transit, risking taste degradation, while air transport costs are 10 times higher than sea transport, limiting large-scale shipments.

Research Background

Thailand's fruit export industry constitutes a vital pillar of its agricultural economy. In 2023, Thailand ranked first among China's fruit import sources, with a 62.8% share of major fruit imports (Figure 2). The case of durian exemplifies the logistics dilemma: while sea transport is cost-effective, its extended transit time makes durians vulnerable to spoilage (5% daily quality decline for mangoes), whereas air transport maintains freshness but restricts scale due to high costs. Land transport, with 2–7 days transit, is hampered by border clearance delays—at the Thailand-Laos border, each shipment experiences an average of 4+ hours of customs procedures, increasing spoilage risks for longan (mildew rate rises 8% with each day of delay).

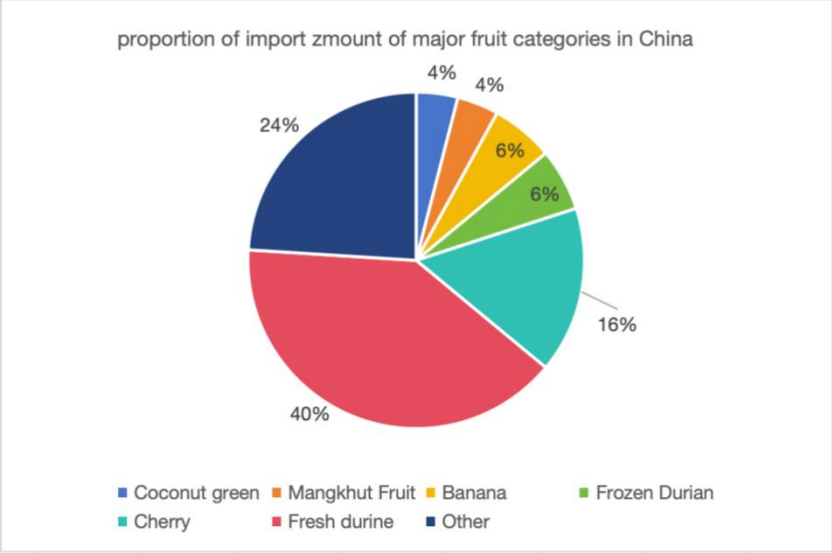
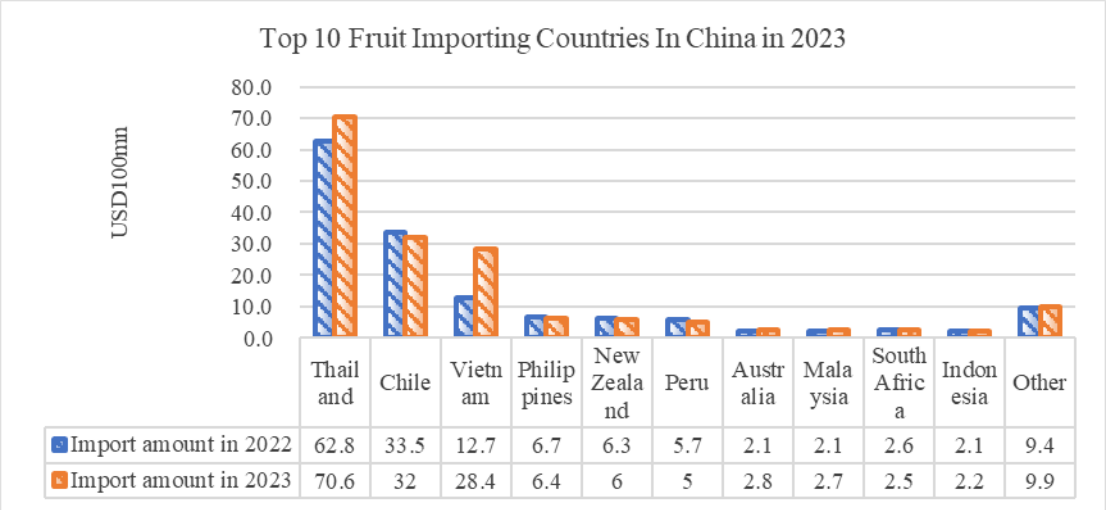


Figure 1 Proportion of import mount of major fruit categories in China

Source: World Agrochemical Network (2024)



	Thailand	Chile	Vietnam	Philippines	New Zealand	Peru	Australia	Malaysia	South Africa	Indonesia	Other
Import amount in 2022	62.8	33.5	12.7	6.7	6.3	5.7	2.1	2.1	2.6	2.1	9.4
Import amount in 2023	70.6	32	28.4	6.4	6	5	2.8	2.7	2.5	2.2	9.9

Figure 2 TOP 10 Fruit Importing Countries in China in 2023

Source: World Agrochemical Network (2024)

Research Problems

Despite Thailand's leading position, three key challenges persist:

1) Sea Transport: 51% of exports face 4–10 days transit, with longan suffering a 15% mildew rate due to inadequate temperature control.

2) Land Transport: Transit times of 2–7 days are compromised by 2–3 hours of border delays at checkpoints with outdated infrastructure.

3) Air Transport: <1% of shipments use air due to high costs (USD 2.5/kg vs. sea's USD 0.2/kg), restricting use to premium mangosteen.

Research Objectives

This study is designed to:

1) Compare sea/land/air transport impacts on Thailand's fruit exports to China.

2) Evaluate cost–efficiency and market satisfaction of current logistics models.

3) Analyze macro/micro factors (e.g., policy, IoT technology) influencing mode selection.

4) Identify opportunities to enhance export competitiveness via multimodal integration

Literature Review

Transportation Mode Selection in Export Logistics

Past studies (Patil et al., 2023; Timilsina & Dulal, 2010) emphasize trade-offs among cost, transit time, and quality. Sea transport offers cost advantages but risks spoilage (e.g., bananas ripen prematurely without temperature control), while air transport ensures speed at a high cost. Land transport is a compromise, but it faces challenges related to border clearance and infrastructure.

Regulatory and Technological Influences

China's 2024 cold chain standards and tariff policies directly impact mode selection—Thai exporters must invest in IoT temperature sensors, increasing costs by 10–15%. Technological innovations, such as AI route optimization, have reduced transit time by 15–20% for specific land routes, demonstrating their potential efficiency.

Theoretical Framework and Hypotheses

Based on the literature review, this study proposes the following hypotheses:

- H1: Sea transport's long transit time negatively impacts product quality (e.g., 5% daily spoilage for mangoes).
- H2: Land transport balances cost and speed for mid-perishable goods.
- H3: Air transport is limited to high-value goods due to cost.
- H4: Regulatory policies (e.g., tariffs) moderate the mode-competitiveness relationship.

This framework serves as the foundation for subsequent empirical research, guiding the data collection and analysis process.

Conceptual Framework

This study follows a systematic research framework to achieve its objectives.

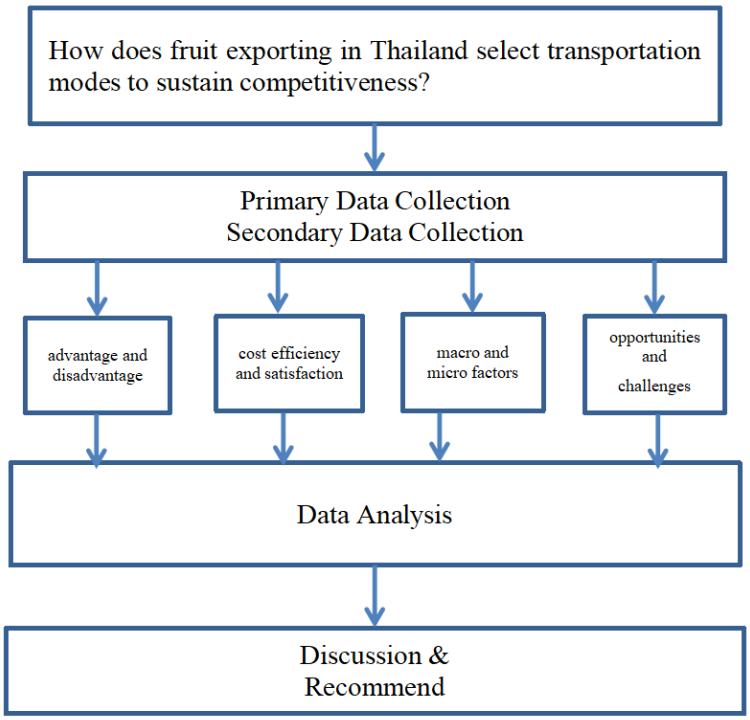


Figure 3 Conceptual Framework

The framework integrates primary data (interviews with 15+ stakeholders) and secondary data (industry reports), employing a mixed-methods analysis to derive recommendations for multimodal logistics.

Research Methodology

Research Background and Rationale

The efficiency of export logistics is of utmost significance for Thailand to maintain its competitive edge in the global fruit market. As the largest importer of Thai tropical fruits, China's demand necessitates that Thailand deliver high-quality fruits in a timely and cost-effective manner, making this a strategic imperative. This study aims to examine the inherent logistics challenges of each transportation mode and conduct a comprehensive comparative analysis to provide a solid basis for informed strategic decision-making and policy development.

Research Objectives and Specific Questions

The primary objective of this study is to establish a comprehensive framework for evaluating the performance of sea, land, and air transport in Thailand's fruit exports to China. The specific research questions include:

1. What are the specific cost, time, and quality indicators associated with each mode of transportation?

2. How do these indicators influence the overall competitiveness of Thailand's fruit exports?

3. What role do external factors such as regulatory policies and technological advancements play in altering these indicators?

4. How can a mixed–mode logistics model be designed to capitalize on the advantages of various transportation modes and mitigate their disadvantages?

Research Design

A mixed–methods approach combines:

– Quantitative: Export statistics from World Agrochemical Network (2021–2023), logistics company cost reports.

– Qualitative: Semi–structured interviews with 10 Thai exporters, 5 Chinese importers, and two government officials, using purposive sampling.

Data Collection

Six logistics companies and three customs offices were selected for data collection. Questionnaires covered cost, transit time, and spoilage rates, while interviews explored policy impacts and technology adoption.

Data Analysis

Quantitative data were analyzed using descriptive statistics (means, SD), while qualitative data underwent thematic analysis to identify codes such as " cost–speed trade–off" and "regulatory challenges".

Validity and Reliability

To ensure the reliability of the research results, this study employs the data triangulation method to cross – validate the quantitative data with the qualitative interview results. The interview guide undergoes a rigorous pre–testing process, and the inter–coder reliability is established by involving multiple researchers in the coding process.

Research Results

Quantitative Results

– Sea Transport: 51% of exports, 4–10 days transit, USD 0.2/kg cost, 5% daily spoilage for mangoes.

– Land Transport: 48% of exports, 2–7 days transit, USD 0.5/kg cost, 2–3 hours border delays.

– Air Transport: <1% of exports, <6 hours transit, USD 2.5/kg cost, 98% freshness retention.

Table 1 Comparative Analysis of Transportation Modes

Transportation Mode	Advantages	Disadvantages	Typical Transit Time	Cost	Environmental Impact
Sea	– Lower costs – High volume capacity – Suitable for non–perishable goods	– Longer transit times – Potential quality degradation – Higher environmental impact	4–10 days	Low	High (due to fuel consumption)
Land	– Shorter transit times – Better control over cargo handling – Suitable for regional exports	– Border delays – Infrastructure limitations – Political risks	2–7 days	Moderate	Moderate (depending on fuel efficiency)
Air	– Fastest transit times – Preserves the freshness of perishable goods – Suitable for high–value goods	– High costs – Limited capacity – Environmental impact due to fuel consumption	3–6 hours	High	High (due to fuel consumption)

Relevant charts vividly illustrate the comparative indicators of these transportation modes, highlighting the significant trade–offs between cost–efficiency and product quality.

Qualitative Results

Interviews revealed:

1. Cost–Speed Trade–off: 80% of exporters use sea–land combined transport for durians, resulting in a 30% cost reduction compared to air transport.

2. Cold Chain Gaps: Outdated border cold storage results in a 15–20% loss of fruit during land transport.

3. Regulatory Impact: The 2024 tariff changes increased import costs by 10–15%, resulting in price hikes or order reductions.

Discussions

Transportation Mode Trade-offs

– Sea Transport: Reefer container technology (intelligent temperature control) can mitigate spoilage, but route optimization (e.g., weather-based scheduling) is needed to reduce transit time.

– Land Transport: The China-Laos Railway (2021) enables sea-rail combined transport, reducing the transit duration of durians to 5 days at 40% lower cost than air.

– Air Transport: Specialized cargo services for high-value fruits (e.g., dedicated cold-chain aircraft) could expand their applications.

Multimodal Integration

A recommended framework combines sea transport for bulk goods, land transport for regional deliveries, and air transport for premium products. IoT cold chain systems (temperature sensors) have reduced sea transport spoilage by 12%, proving technology's role in enhancing competitiveness.

New Knowledge from Research

This study, through a comprehensive analysis of the impact of transportation mode selection in Thailand's fruit export logistics, has not only verified existing theories but also contributed new knowledge. To better understand and demonstrate how this new knowledge is generated, this study introduces the SECI model (Nonaka & Takeuchi, 1995), a framework that describes the process of knowledge creation and transformation within organizations. The SECI model includes four processes: Socialization, Externalization, Combination, and Internalization.

Application of the SECI Model in This Study

1. Socialization: In the early stages of this study, we collected a wealth of experiential knowledge and tacit knowledge through in-depth interviews with Thai exporters, Chinese importers, logistics managers, and government officials. This process is socialization because it involves direct interaction between individuals and the transfer of experiential knowledge.

2. Externalization: Through interviews and data collection, we transformed this tacit knowledge into more concrete data and information, such as transportation costs, time, quality, and environmental impact. This process is externalization because it converts individual tacit knowledge into organizational explicit knowledge.

3. Combination: During the data analysis phase, we combined the collected data with existing literature and theories to form a comprehensive understanding of the impact of different transportation modes. This process is combination because it involves the integration of explicit knowledge from different sources.

4. Internalization: Finally, through in-depth discussion and the formation of strategic recommendations, we transformed this explicit knowledge into new tacit knowledge, providing guidance for future decision-making and research. This process is internalization because it involves converting explicit knowledge into individual tacit knowledge.

Conclusion

This study confirms:

1) Sea transport is suitable for durable fruits like bananas, but 4–10 days of transit pose quality risks.

2) Land transport achieves 2–7 days of transit for $0.5/kg, making it suitable for moderately perishable fruits, such as durians, although infrastructure needs improvement.

3) Air transport ensures the freshness of high-end fruits like mangosteens, but the cost of $ 2.50/kg restricts their large-scale application.

In the future, it is necessary to simplify customs clearance processes through Sino-Thai customs collaboration, upgrade cold chain facilities with IoT technology, and construct an integrated multimodal transport system combining "sea, land, and air" to comprehensively enhance the competitiveness of Thai fruits in the Chinese market.

Suggestions

Strategic Recommendations

1) Multimodal Transport Strategy: Utilize sea transport during off-seasons to lower costs, and adopt a "land-to-air" transport model for perishable fruits, such as durians, during peak seasons to balance costs and freshness.

2) Technological Upgrades: Deploy IoT sensors in containers and warehouses to monitor temperature and humidity in real time, potentially reducing loss rates by 10–15%.

3) Policy Coordination: Promote the establishment of a unified electronic customs clearance platform between China and Thailand, aiming to shorten border clearance time by 30–40% by referencing the China–Laos Railway model.

4) Infrastructure Investment: Deploy intelligent cold storage at border ports, upgrade port loading/unloading equipment, and enhance cold chain continuity.

5) Public–Private Partnerships: The government should guide enterprises to participate in smart logistics park construction through tax incentives, integrating logistics resources to reduce industry costs.

References

Nonaka, I., & Takeuchi, H. (1995). *The knowledge–creating company: how Japanese companies create the dynamics of innovation.* Oxford University Press.

Patil, R. A., Patange, A. D., & Pardeshi, S. S. (2023). International transportation mode selection through total logistics cost–based intelligent approach. *Logistics, 7*(3), 60. https://doi.org/10.3390/logistics7030060

Timilsina, G. R., & Dulal, H. B. (2010). Urban Road Transportation Externalities: Costs and the Choice of Policy Instruments. *The World Bank Research Observer, 26*(2), 162–191. https://doi.org/10.1093/wbro/lkq005

World Agrochemical Network. (2024, May 13). *China's fruit imports and exports both grew in 2023, with the import value exceeding $16.8 billion*. Agropages. https://cn.agropages.com/m/