Route Selection of Thai Fruit Maritime Logistics between Thailand and southern China

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Abstract

With the establishment of CHINA-ASEAN free trade area in 2010 and the advancement of the "One Belt and One Road" policy, trade has been heating up between Thailand and China. Thailand is famous for being rich in tropical agricultural products, especially fruit and vegetable with huge export potential. The continuous improvement of logistics network ensures the rapid development of fruit trade. At present, as the fresh fruit is perishable food with high requirements on temperature and humidity, refrigerated container shipping logistics is an important guarantee for the export quality of fruits in Thailand. Therefore, marine transportation is the main logistics mode for the export of fruits and vegetables from Thailand to China. This research study the optimal maritime logistics route between Thailand and China, the paper takes Laem Chabang and Bangkok port as the starting point, and analyzes the factors such as transport cost, transport time, customs clearance and transport capability, comparison these four paths of maritime logistics. Among these, time and cost are quantitative indicators while customs clearance and transport capacity are qualitative indicators, so AHP method is adopted to establish the model.

Keywords: Thai Fruit Maritime, Logistics, Route Selection, Analytic Hierarchy Process (AHP)

Introduction

With the advancement of “One Belt And One Road” policy and the establishment of CHINA-ASEAN Free Trade Area (CAFTA), Sino-Thai bilateral trade has been increasing continual (Narintarakul & Kingkorn, 2004). Especially, the “early harvest” (agricultural products) program has started, fruit and vegetable trade have an important role and also are showing a new momentum and broad development prospects between China and Thailand in international trade (Denny Roy, 2005). Since the beginning of this century, with the implementation of the Tariff-Free Agreement on the 80 kinds of fruit and108 kinds of vegetables trade by China and Thailand, the trade of fruit has increased steadily and gradually and developed into their largest import and export target market of fruits.

Thailand is located in the center of Southeast Asia. Its geographical location and climatic conditions are very suitable for the growth of fruits (BichouK, Gray R, 2004). Fresh tropical fruits have become an important economic crop in Thailand. With the increase of export quantity, the Thai government attaches more and more importance to the planting and production of fruits. (Edward Wong, 2010). As a result of Thailand fruit variety diversity, quality is good, yield is high, price is low, and can produce current market, these advantage make Thailand fruit is loved deeply by domestic and international consumer. In 2013-2018, Thai fruit exports to China mainly include durian, mangosteen, longan, mango, rambutan, banana, mandarin orange, pineapple, tamarind,

papaya, grape, etc. Among them, durian, mangosteen, longan, mango, rambutan and lychee are seasonal fruits of Thailand (Boonla T, 2012). Banana, mandarin, pineapple, tamarind, papaya and grape are perennial fruits. According to the size of the export amount, the top three fruits are durian, longan and mangosteen, all of which are seasonal fruits (Womack J P, Jones D T, 2013).In the first half of 2018, Thailand's agricultural sector expanded by 8.3 percent, comparing with a 10.4 percent expansion in the same quarter last year. Agricultural Production Index grew by 12.0 percent, while Agricultural Price Index decreased by 9.2 percent and Farm Income Index rose by 1.7 percent.

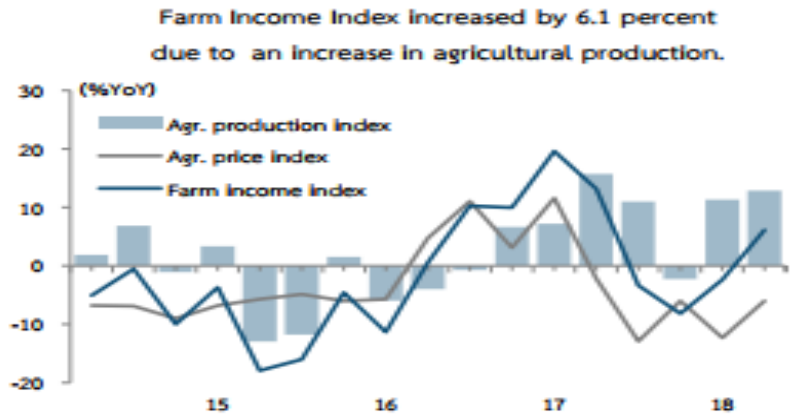

Figure 1 Farm Income Index Increased by 6.1 Percent Due to an Increase in Agricultural Production

Source: Office of Agricultural Economic, Thailand

Export value increased by 11.1 percent. In baht term, export value increased by 1.6 percent. Export value of agricultural commodities increased by 7.8 percent, a recovery from a 1.6 percent decline in the previous quarter.

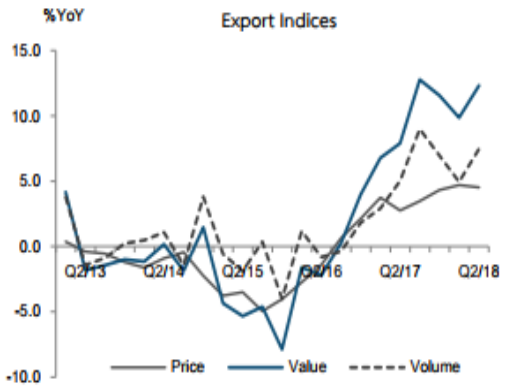

Figure 2 Export Indices

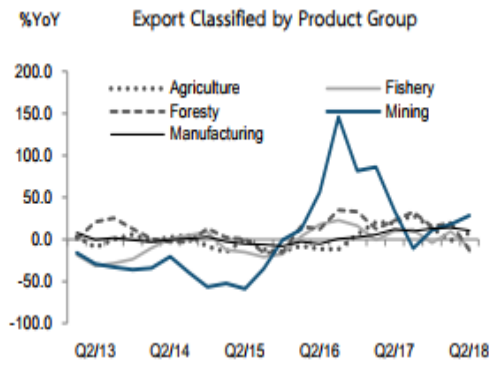

Figure 3 Export Classified by Product Group

Source: Bank of Thailand

According to Thai customs statistics, Thailand's imports and exports of goods were $288.45 billion in the1-7 months of 2018, up 11.6 percent from the same period last year (the same below). Of this, exports were $144.65 billion, up 9.6 percent. Imports were $143.8 billion, up 13.7 percent. Trade surplus of $850 million, down 84.6%In the1-7months, bilateral exports and imports of goods from Thailand and China rose 10.7 percent to $45.63 billion (Drelich-Skulska, boguslawa, 2011).The exports of Thailand to China rose by 6% to $17.14 billion, accounting for 11.9% of Thailand's total exports. Imports from China totaled $28.49 billion, up 13.7 percent, accounting for 19.8 percent of Thailand's total imports. Thailand's trade deficit was $11.35 billion, up 27.6 percent. As of July, China is Thailand's largest export market and source of imports, and its largest trading partner.

In recent years, the scale of international trade has been expanding between China and Thailand, and the logistics network will become an important part of the trade development. Thailand has become an important international logistics hub with geographical advantages (Rodolfo C.Severino, 2010). In October 2013, the ministry of commerce of Thailand stated publicly that, in order to adapt to the need of the ASEAN economic community to connect with each other, Thailand is determined to reduce the cost of exports and strive to become a cargo transfer station in the world's two most important markets, China and India. The Thai government plans to build an ASEAN logistics center by 2020 (Liunaijie, 2009).

Source: University of Fudan, 2012. As fresh fruits and vegetables are perishable food with high requirement on temperature and humidity, refrigerated container shipping logistics is an important guarantee for the export quality of fruits and vegetables in Thailand (Defraeye T, Kirkman W, 2016) . Therefore, marine transportation is the main logistics mode for the export of fruits and vegetables from Thailand to China.

1) LaemChabang--Hong Kong--Guangzhou Jiangnan Fruit and Vegetable Wholesale Market-- Fruit markets across the country-Consumers

Table 1 Thai Fruit Shipping from Laem Chabang Port Via Hong Kong Port to Fruit Markets Cost

Number	Content	$/40 Feet TEU (About 20 tons)
1	Freight from LaemChabang to Hong Kong	1150
2	Hong kong Service Charge	658
3	Customs Fees	440
4	VAT	1556
5	Freight from Hong kong to Guang zhou Jiangnan Fruit and Vegetable Wholesale Market	700
6	Management Fee for Guangzhou Jiangnan Fruit and Vegetable Wholesale Market	400
7	Freight from Guangzhou Jiangnan Fruit and Vegetable Wholesale Market to Fruit markets across the country	

Source: Report on the logistics system for Thai agricultural exports 2017

Table 2 Customs Clearance Environment

	Hong Kong Port
Work Mode	"Paperless" management, all service object
Declaration and Inspection	Declare in advance, declare business, open box to sample check for many times, the customs and inspection quarantine are far apart from each other
Handle Procedures	Different departments work separately
Customs Clearance Time	Declaration Time: 3 hours Tax Time: 1 day Quarantine Time: 3 days Sanitary Certificate: 1 day Goods Clearance; 1 day
Total	Within six days

Source: Hong Kong custom 2017

2) LaemChabang-Shenzhen-Guangzhou Jiangnan Fruit and Vegetable Wholesale Market-Fruit markets across the country-Consumers

Table 3 Thai Fruit Shipping from Laemchabang Port via Shenzhen Port to Fruit Markets Cost

number	Content	$/40 Feet TEU (About 20 tons)
1	Freight from LaemChabang to Shenzhen	1300
2	Shenzhen Service Charge	842
3	Customs Fees	780
4	VAT	1986
5	Freight from Shenzhen to Guangzhou Jiangnan Fruit and Vegetable Wholesale Market	330
6	Management Fee for Guangzhou Jiangnan Fruit and Vegetable Wholesale Market	400
7	Freight from Guangzhou Jiangnan Fruit and Vegetable Wholesale Market to Fruit markets across the country	

Source: Report on the logistics system for Thai agricultural exports 2017

Table 4 Customs Clearance Environment

	Shenzhen port
Work Mode	"Paperless" policies, generally serve large enterprises
Declaration and Inspection	Declare ahead of schedule, need to submit two times to examine two times to let go commonly, custom and inspection quarantine are far apart
Handle Procedures	Multi-station type of procedures, enterprises to customs inspection and quarantine of the customs and excise department of the customs and excise department
Customs Clearance Time	Customs Declaration: 3 hours Tax Time: 1 day Quarantine Time: 5 days Sanitary Certificate: 2 days Goods Clearance: 1 day
Total	Within seven Days

Source: Shenzhen Custom 2017

3) LaemChabang--FangChengGang--Nangning Haijixing Fruit and Vegetable Wholesale Market--Fruit markets across the country--Consumers

Table 5 Thai Fruit Shipping from Laemchabang Port via Fangchenggang Port to Fruit Markets Cost

number	Content	$/40 Feet TEU (About 20 tons)
1	Freight from LaemChabang to Fangchenggang	1210
2	Fangchenggang Service Charge	774
3	Customs Fees	624
4	VAT	1985
5	Freight from Fangchenggang to Guangzhou Jiangnan Fruit and Vegetable Wholesale Market	375
6	Management Fee for Nanning Haijixing Fruit and Vegetable Wholesale Market	400
7	Freight from Nanning Haijixing Fruit and Vegetable Wholesale Market to Fruit markets across the country	

Source: Report on the logistics system for Thai agricultural exports 2017

Table 6 Customs Clearance Environment

	Fang chenggang Port
Work Mode	"Paperless" reform does not restrict large, medium and small enterprises
Declaration and Inspection	Declaration in advance, one inspection and one release, customs and quarantine
Handle Procedures	Promote the "one stop window" service
Customs Clearance Time	Declaration Time (including tax) : 3 hours Quarantine Time: 3 days Sanitary Certificate: 1 day Goods Clearance: 1 day
Total	Within five days

Source: Guangxi custom 2017

4) Bangkok- Shanghai- Shanghai Longwu Imported Fruit and Vegetable Wholesale Trading Market-Markets in Shanghai, Yiwu and Northeast Provinces-Consumers

Table 7 Thai Fruit Shipping from Bangkok Port via Shanghai Port to Fruit Markets Cost

Number	Content	$/40 Feet TEU (About 20 tons)
1	Freight from Bangkok to Shanghai	1350
2	Shanghai Service Charge	821
3	Customs Fees	790
4	VAT	2015
5	Freight from Shanghai to Longwu imported fruit and vegetable wholesale trading market	365
6	Management Fee for Longwu imported fruit and vegetable wholesale trading market	420
7	Freight from Longwu imported fruit and vegetable wholesale trading market to Markets in Shanghai, Yiwu and Northeast Provinces	

Source: Report on the logistics system for Thai agricultural exports 2017

Table 8 Customs Clearance Environment

	Shanghai Port
	"Paperless" reform does not restrict large, medium and small enterprises
Work Mode	Declaration in advance, one inspection and one release, customs and quarantine
Declaration and Inspection	Promote the "one stop window" service
Handle Procedures	Declaration Time (including tax) :4 hours Quarantine Time :4days Sanitary Certificate: 2days Goods Clearance:1day
Customs Clearance Time	Within seven days

Source: Shanghai Custom 2017

Method

Research Design

This research is a mixed method research design composing of qualitative and quantitative approach using survey questionnaire and AHP to collect data from Select optimal route of fruit maritime logistics between Thailand and China. The research employs AHP to considering the choice of transportation routes as a decision. The goal of the decision is to choose the most suitable route, and there are four factors influencing the decision include transport cost, transport time, customs clearance time and transport capacity. When the enterprise is making the choice of transportation route, it is dealing with the problem of a multi-objective decision. The choice of route by AHP is a scientific and practical method.

Research Framework

The optimal path selection of fruit trade is obtained through AHP and calculation of three major transport factors, including transport cost, transport time, customs clearance, transport capacity, so as to achieve the goal of reducing transport time, shortest customs clearance time and relatively optimal transport cost, improving transport capacity.

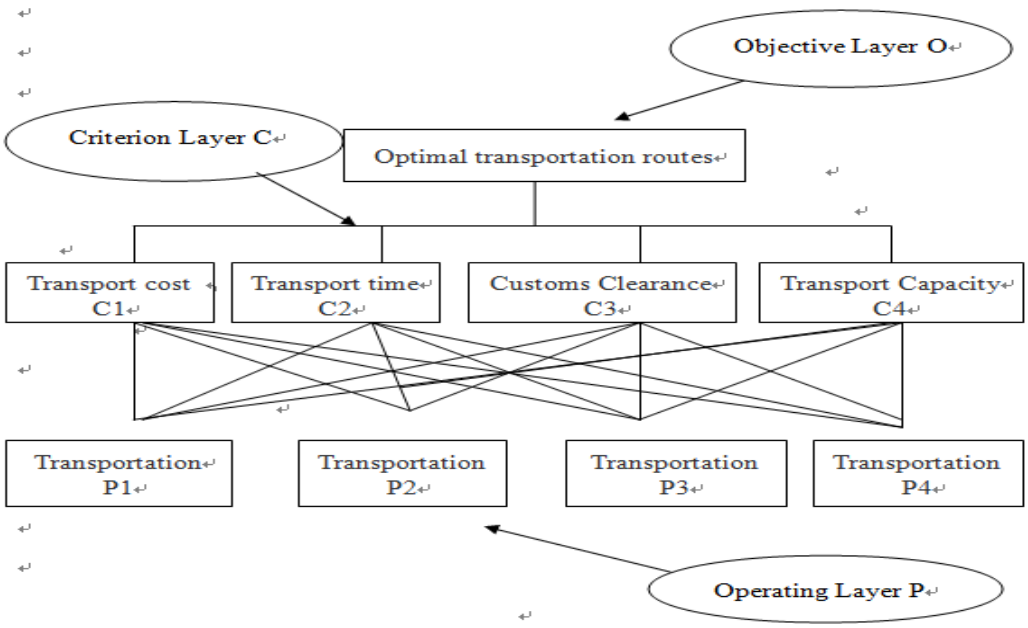

Figure 4 AHP model structure diagram of Thai-China logistics path

Model Construction

1) Establish a Stepped Hierarchy

Decision makers should select the influencing factors according to the specific problems and construct the appropriate hierarchy. Hierarchy division should be established according to the specific situation, and the general hierarchy structure will include target layer, criterion layer, sub-criterion layer, scheme layer, etc.

2) Construct the Judgment Matrices

After establishing the hierarchical hierarchy, we can determine the subordinate relationship between the elements of the upper and lower levels, and then construct the judgment matrix from top to bottom according to the hierarchical hierarchy model. All elements in each layer are compared in pairs according to the scale method of 1-9 based on the criterion of each element in the adjacent upper layer, so as to construct a judgment matrix, as shown in the table.

Table 9 Meaning of Each Scale in Scaling Method

Scale	Definition	Implication
1	Equal Importance	Both elements are equally important to a criterion
3	Slight Importance	Two elements are slight importance to one criterion, and one element is slight importance to the other
5	Obvious Importance	Two elements are obvious importance to one criterion, and one element is obvious importance to the other
7	Strong Importance	Two elements are strong importance to one criterion, and one element is strong importance to the other
9	extreme Importance	Two elements are extreme importance to one criterion, and one element is extreme importance to the other
2,4,6,8	Median of Adjacent Scale	Represents the scale between two adjacent scales

3) Consistency Test

Due to the large number of paired comparisons, it is difficult to achieve complete consistency. In order to solve the problem of consistency, AHP also provides a method for decision makers to make comparison to obtain consistency.

4) Determine the Best Solution

This process is calculated layer by layer from the highest level to the lowest level, that is, the weight of relative importance of the same level element to the upper level is calculated, so as to determine the total order of each scheme in the selected evaluation indicator system, and then choose the optimal scheme for multi-objective decision.

Research Findings and Discussion

The first step is to establish the hierarchical structure model. In this paper, we divide the model into three layers: target layer, criterion layer and measure layer. The target layer is the optimal choice of logistics channel. The criteria layer is the related factors influencing the final decision, including transport cost, transport time, customs clearance and transport capacity. The measure layer is the logistics channel of cargo transportation. In the second step, a comparison matrix is constructed to compare the influence of four factors, namely, transport cost, transport time, customs clearance and transport capacity, on each factor of the measure layer. Usually, a pair wise comparison method is adopted. Construct a contrast matrix.

1) Program One (with time as the main object)

In the AHP method, the scale chart below is used to describe the relative weight in people's mind.

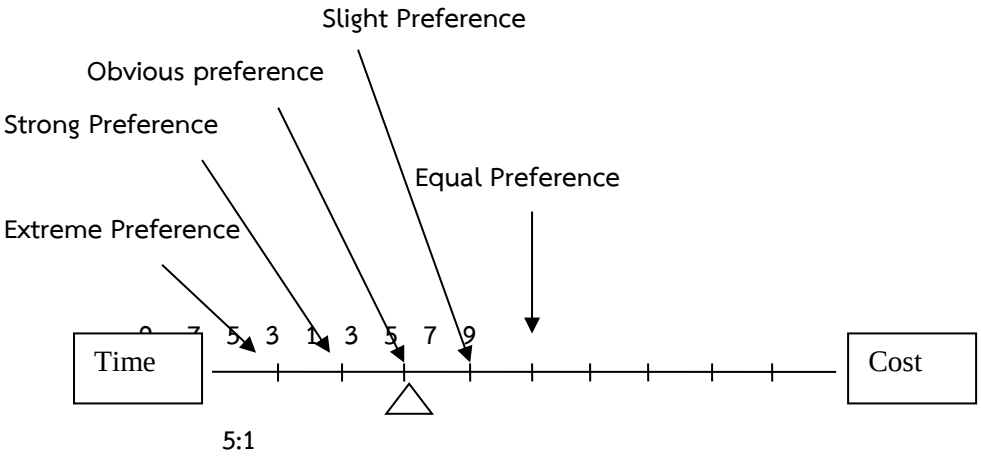

Figure 2 Meaning of Each Scale in Scaling Method

In the figure, the current degree represents the degree of preference. For example, 5:1 indicates a strong preference for time cost. That is to say, when choosing the transport channel, it is more important to be short in time. Cost is not the main reference factor. By analogy, the weights of other factors at the criterion layer are tabulated to form a comparison matrix. Shown in the table below:

Table 10 Criterion Layer Comparison Matrix

0	Transport Cost	Transport Time	Customs Clearance	Transport Capacity
	C1	C2	C3	C4
C1	1	5	7	7
C2	1/5	1	3	3
C3	1/7	1/3	1	2
C4	1/7	1/3	1/2	1

After the matrix is sorted and normalized, the weight is:

W0=(0.643, 0.194, 0.097, 0.067)T

In the analytic hierarchy process (AHP), the judgment matrix should satisfy the consistency test of the matrix. Firstly, the consistency judgment indicator CI is calculated as formula (4.1), and then the consistency rate CR is constructed as formula (4.2). Here, we bring in a measure. It's called the stochastic consistency index RI. As follows:

Table 11 The Stochastic Consistency Index RI

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.5	1.49	1.51

When n≥3时, CR<0.10, The judgment matrix can be accepted; otherwise, the judgment matrix should be corrected.

The matrix consistency indicator CI and the random consistency ratio CR are as follows:

CI=(4.139-4)/(4-1)=0.046

CR=(0.046)/(0.9)=0.051<0.1

Therefore, the judgment matrix of criteria layer C has acceptable consistency in China-Thailand maritime cargo trade and logistics channel.

We determine the weight of quantitative indicators. This paper is based on the comparison of the data collected from the actual survey. In logistics cost, the less the transport cost, the better, the shorter the time cost. Therefore, the reciprocal value of the cost (time cost or expense cost) of each logistics channel over the total cost (time cost or expense cost) can be used as the weight. The cost is smaller, the weight is larger and the priority level is higher. For such qualitative indicators of channel condition and transport capacity, the weights of these two indicators are determined according to the field survey and the practical experience of relevant practitioners.

Table 12 Calculation of Quantitative Index of Transportation Cost in Each Route

(unit of a standard container 40 feet)

	Transport cost ($)	Cost / Total	Reciprocal
Route1	3904	39040/199060=0.196	5
Route2	5638	56380/199060=0.283	3
Route3	4603	46030/199060=0.231	4
Route4	5761	57610/199060=0.289	3
Total	19906		

Table 13 Calculation of Quantitative Index of Transportation Time in Each Route

	Time (day)	Time / Total	Reciprocal
Route1	6.833	6.833/26.748=0.255	4
Route2	5.416	5.416/26.748=0.202	5
Route3	4.374	4.374/26.748=0.164	6
Route4	10.125	10.125/26.748=0.379	3
Total	26.748		

Table 14 Calculation of Quantitative Index of Customs Clearance Time in Each Route

	Customs clearance (day)	Time / Total	Reciprocal
Route1	6	6/25=0.24	4
Route2	7	7/25=0.28	3
Route3	5	5/25=0.20	5
Route4	7	7/25=0.28	3
Total	25		

Table 15 Calculation of Qualitative Index of Customs Clearance Environment in Each Route

	P1	P2	P3	P4
Route1	1	3	3	1/3
Route2	1/3	1	1	1/5
Route3	1/3	1	1	1/5
Route4	5	5	5	1

Table 16 Calculation of Qualitative Index of Transport Capacity in Each Route

	P1	P2	P3	P4
Route1	1	1	1	1/5
Route2	1	1	1	1/5
Route3	1	1	1	1/5
Route4	5	5	5	1

The fourth step is the weight of each index of P layer is calculated

Similarly, the judgment matrix of c-p layer can be constructed first to determine the weight of Pl, P2, P3 and P4 in the measure layer on transport cost, transport time, customs clearance environment and transport capacity. The results were calculated and summarized as follows:

The weight of C1 is W1=(0.294， 0.294， 0.235， 0.176)T ；

The weight of C1 is W2=(0.267， 0.2， 0.267， 0.267， 0.267)T ；

The weight of C1 is W3=(0.252， 0.097， 0.097， 0.555)T ；

The weight of C1 is W4=(0.125， 0.125， 0.125， 0.625)T

Judging the consistency of indicators, as shown in the following table:

Table 17 Judging the Consistency of Indicators

Judgment Matrix	n	λmax	CI	RI	CR
A0	4	4.139	0.046	0.9	0.051
A1	4	4	0	0.9	0
A2	4	4	0	0.9	0
A3	4	4.044	0.015	0.9	0.017
A4	4	4	0	0.9	0

It can be seen that CR< 0.10 for all the four judgment matrices can pass the consistency test

The fifth step is the comprehensive importance calculation

Route P1: Laem chabang –HongKong Total Score is:

0.643 ×0.294+0.194×0.267+0.097×0. 252+0.067×0.1 25=0.274

Route P2: Laem chabang –Shenzhen Total Score is:

0.643×0.294+0.1 94×0.2+0.097×0.097+0.067×0.1 25=0.246

Route P3: Laem chabang –Fangchenggang Total Score is:

0.643×0.235+0.194×0.267+0.097×0.097+0.067x0.125=0.221

Route P4: Bangkok –Shanghai Total Score is:

0.643 ×0.176+0.94×0.267+0.097 x0.555+0.067×0.625=0.261

In summary, PI> P4 > P2 > P3 are optimal when taking time as the main consideration object, followed by P4 line, P2, and finally P3.

2) Program Two (Mainly Focus on Transport Cost)

The Comparison Matrix of Each Factor is Constructed:

Table 18 Criterion Layer Comparison Matrix

0	Transport Cost	Transport Time	Custom Clearance	Transport Capacity
	C1	C2	C3	C4
C1	1	1/5	3	3
C2	5	1	7	7
C3	1/3	1/7	1	2
C4	1/3	1/7	1/2	1

After the matrix is sorted and normalized, the weight is:

$\lambda max=1/4 *((0.815)/(0.194)+(2.761)/(0.643)+(0.388)/(0.0974)+(0.272)/(0.067)) = 4.139$

The matrix consistency indicator CI and the random consistency ratio CR are as follows:

$CI=(4.139-4)/(4-1)=0.046$

$CR=(0.046)/(0.9)=0.051<0.1$

Therefore, the judgment matrix of criteria layer C has acceptable consistency in China- Thailand maritime cargo trade and logistics channel. As the criteria layer has not changed the evaluation criteria for each scheme. Therefore, the weight of each scheme is not changed by the criterion layer, which is still the same as the above calculation results. Therefore, there are:

Route P1: Laem chabang –HongKong, Total Score is :

0.194 x0.294+0.643 x0.267+0.097×0.252+0.067×0.1 25=0.262

Route P2: Laem chabang –Shenzhen, Total Score is:

0.194x0.294+0.643x0.2+0.097x0.097+0.067X0.125=0.203

Route P3: Laemchabang –Fangchenggang, Total Score is ;

0.194 x0.235+0.643 x0.267+0.097 x0.097+0.067x0.125=0.235

Route P4: Bangkok –Shanghai, Total Score is ：

0.194 x0.176+0.643 x0.267+0.097 x0.555+0.067x0.625=0.302

To sum up, P4> P1> P3 > P2 are optimal when cost is the main consideration object, followed by P1, P3 and finally P2.

When time is the main consideration object, PI> P4 > P2 > P3 are optimal, followed by P4 line, P2, and finally P3. When cost is the main consideration object, P4> P1> P3 > P2 are optimal, followed by P1, P3 and finally P2.Comprehensive program one and program two: the optimal logistics channel for the goods trade of Thailand to China should be P1 (Laemchabang-Guangzhou) line and P4 (Bangkok-Shanghai) line (ranking the first two). If the time factor is taken as the main object of consideration, the P1 (Laemchabang-Guangzhou) line is even better than P4(Bangkok-Shanghai) line.

Conclusion and Recommendation

Conclusion

When an enterprise is making decisions about transportation mode and route, it needs to consider a variety of factors, including transportation cost, transportation time, customs clearance environment and transportation capacity. For different enterprises, the main factors influencing the decision-making are different, which requires them to score various indicators according to experts and industry experience, and then obtain quantitative results.Based on the research on fruit shipping logistics in China and Thailand, this paper analyzed the characteristics of taking fruit as the object of logistics transportation, and selected quantitative and qualitative indicators to build the hierarchy according to the considerations of enterprises in the choice of transportation mode. Through the analytic hierarchy process (AHP), this paper can help the fruit traders in

China and Thailand to select the most suitable general method and mode of transportation according to their own situation and goals. In summary, when taking time as the main consideration object, PI> P4 > P2 > P3 are optimal, followed by P4 line, P2, and finally P3. When cost is the main consideration object, P4> P1> P3 > P2 are optimal, followed by P1, P3 and finally P2.

Recommendations

1) To the Government. China and Thailand government should intensify the construction of the port is put into the port infrastructure construction, in particular, and to expand the ability of port connected to the surrounding city, form a clear logistics networks. Thailand and China should strengthen bilateral customs cooperation, optimize the environment for cross-border customs clearance, improve the timeliness of customs clearance, and reduce the cost of logistics enterprises. China and Thai government should implement preferential tax policies to stimulate the development of logistics enterprises. 2) To the Maritime Logistics Industry. It is the key to enhance the market competitiveness of Sino-Thai logistics enterprises to actively promote the transformation of small and medium-sized logistics enterprises from traditional to intensive. China and Thailand should promulgate laws and regulations closely related to the logistics industry and strengthen supervision and law enforcement. 3) To the Enterprise. China and Thailand enterprises need to actively introduce excellent logistics management personnel, increase capital and technical input logistics enterprises, Strengthen the construction of informationization of logistics network, improve the logistics service capability. Thailand enterprises should Optimize market choices, improve our ability to respond to market risks, control logistics cost risk and avoid related loss and improve logistics efficiency and reduce time cost.

Limitations

As a process of multi-objective analysis, the study of transportation mode and route selection is affected and restricted by many factors. Although the research in this paper USES scientific methods, there are still a few problems: 1) Although this study is based on the collection of large amounts of data and field research, as a highly sensitive product, there are still many key data that cannot be obtained, which may affect the final research results to some extent. 2) As an exploratory research, both the import and export of fruits and the establishment of China's coastal cities as an important distribution center are closely related to the policy orientation of the two countries. Therefore, this study is based on the discussion of a positive market operation, which may be different from the actual situation.3) Lack of theoretical basis and practical experience. In the establishment of the weight index model, I mainly focused on the direction of three key indicators, and the actual operation process would be more complicated.

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