Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 45 No. 1 (2024)

Determining the Selection Factors of Thai Rice Products in Chinese Market using Analytical Hierarchy Process (AHP)

Supakyada Kulthunyahirun[1], Boonsub Panichakarn[2]
[1] *School of Economics, Guangxi University, Nanning, Guangxi, China*
[2] *Faculty of Logistics and Digital Supply Chain, Naresuan University, Phitsanulok, Thailand*

Abstract:- Agricultural and agro-industrial products constitute nearly 25% of Thailand's product exported to China. Among these, rice products rank within the top 5 of Thai agricultural exports to China. Research indicates that the proportion of Thai rice exports to China has experienced a decline, dropping from 37.9 percent of total exports in 1998 to 10.2 percent in 2018. In terms of Thai rice export to China, White rice and Jasmine rice stand out as the prominent varieties. These two varieties collectively account for more 60% and 50% of the total volume of rice exported. The selection factors of Thai rice within the Chinese market have been analyzed through the application of the Analytical Hierarchy Process (AHP). A survey was conducted among ten selected target respondents across Guangdong, Yunnan, Fujian, and Guangxi provinces. The results are ranked with the quality factor as the top priority, followed by the finance and accessibility factors.

Keywords*: Thai rice products, Selection factors, Analytical Hierarchy Process (AHP)*

1. Introduction

In the context of the export product structure, the summary of agricultural and agro-industrial products constitutes nearly 25% of Thailand's exports to China. The flow of Thai agricultural exports to China has experienced an upward trend from 1998 to 2018, with the top 5 products being rubber, cassava, fresh and frozen fruits, rice, and oilseed plants. Consequently, the promotion of agricultural and processed product exports to China is significant for the export sector and Thailand's broader economic and social structure (Orrasa Rattana-amornpirom, 2020) [i].

According to the Information and Communication Technology Center, Ministry of Commerce, 2019[ii], the longstanding international trade between Thailand and China can be attributed to China's higher demand, insufficient local Chinese production, and the diversity of product types involved. From 1998 to 2018, the share of Thai rice exports to China declined significantly, dropping from 37.9 percent of total exports to merely 10.2 percent, and the importation of rice products from China into Thailand is rare.

The Supply and Demand dynamics in Thailand from 2000 to 2018, as reported by FAO (2022) [iii], depict a consistent surplus of rice production compared to domestic demand. Notably, Thailand has the capacity to annually export approximately 10 million tons of rice to foreign markets. The peak surplus during 2011-2013 reached 16.981, 17.611, and 16.243 million tons respectively. Over the years, the China-Thailand rice trade has experienced substantial growth, expanding from 250,000-300,000 million tons in 2000-2002 to 10,000,000-11,000,000 million tons in 2016-2018. This trade constitutes 9-10% of the total trade during 2015-2018, signifying the significant importance of the China market as a target for Thailand's rice exports (Thai Rice Exporters Association, 2019) [iv]. According to the FAO in 2022, the analysis of Thai rice exports to China reveals that White rice and Jasmine rice constitute the predominant share. These two varieties collectively contribute to over 60% of the total value and around 50% of the total volume. Over the years, there has been a noteworthy price escalation for Jasmine rice per ton, with an increase from 328.6 US dollars in 2002 to a substantial 920.2 US dollars in 2018, reflecting a remarkable surge of approximately 180%. Similarly, the price of White rice demonstrated a significant upward trend, growing from 285.9 US dollars per ton in 2002 to 597.6 US dollars per ton in 2018, reflecting an increase of about 109%. During the period spanning 2007-2011, the export of Thai rice to China faced

considerable challenges, except for Glutinous rice. This was attributed to the contamination of Thai rice and the influence of the Thai Government's rice Pledging Policy.

2. Literature Review

The Department of Internal Trade under the Ministry of Commerce (2019) [v] has categorized the crop calendar into two primary types; Seasonal agricultural products and non-seasonal agricultural products. Seasonal agricultural products include various crops, fruits, and other items that are produced during specific seasons. These crops include garlic, coffee, paddy, maize, soybean, cassava, shallot, and onion. Fruits such as rambutan, durian, mangosteen, long kong, longan, lychee, and tangerine are also part of this category. Additionally, sea salt is listed under this grouping. The non-seasonal agricultural products include palm oil, ripe coconut, para-rubber, and pineapples. Livestock and aquatic animals, such as shrimp, chicken, eggs, pigs, and other fish products, are categorized under this type. Prisana Suwannaporn and Anita Linnemann (2008) [vi] conducted a study revealing that rice does not replace other staple foods, primarily due to price fluctuations. This disparity is influenced significantly by factors such as product quality, differentiation, and pricing strategies. Thailand must establish a strong reputation by prominently highlighting the country of origin. In a separate study by Sathapatyanon and Kuwornu (2018) [vii], an examination of the rice supply chain led to the identification of two distinct relationships. These relationships are categorized into two-stages networking. The first is identified by the cooperative for agricultures, the rice producer, and another related cooperative, the rice buyer. The second one identifies a connection through supply chain from the starting cooperative (producer), intermediary cooperative, and ending cooperative (buyer). Wattanutchariya (2016) [viii] discussed the production of parboiled rice. The process is begun with the paddy selection process, pre-cleaning, the vessel activities (pre-steaming, soaking, steaming), pre-dryers, column dryers, storage silos, pre-cleaner, milling, whitening, and grading. Every step of the supply chain of parboiled rice belongs to three activity-types which are value added (VA), non-value added (NVA), and necessary-non-value added (NNVA). Prasertwattanakul and Ongkunaruk (2018) [ix] arrived at a conclusion after they investigated a case involving a medium-sized rice company. Their analysis of supply chain integration highlighted the significance of vertical development in enhancing both the quality and quantity of organic rice. Additionally, their research meticulously delineated the organic rice supply chain within a medium-sized Thai company, providing a comprehensive visual representation. Thasanee Satimanon (2016) [x] briefly outlined the originally declared objective of the rice-pledging scheme to bolster farmers' household income. However, within its second year of implementation, this initiative unveiled several concerning "side effects." Firstly, the absence of restrictions on the volume of rice eligible for the guaranteed price led to an escalating budget deficit, posing a significant financial burden on Thai taxpayers. Secondly, a growing chorus of critics began to raise allegations of "corrupt practices" permeating the functioning of the pledging scheme. Thirdly, it became increasingly apparent that the guaranteed price was distorting farmers' behavior, as they lacked any incentive to enhance the quality of their rice produce. Finally, in June 2014, the new military government made a decisive announcement that marked the discontinuation of the rice-pledging scheme.

Boonjit Titapiwatanakun (2012) [xi] conducted research that highlighted a gradual reduction in the role and significance of rice within the Thai economy. As the landscape of the domestic and international markets continually evolves, this changing dynamic underscores the need to reconsider the overall direction of Thailand's rice industry. Witsanu Attavanich (2015) [xii] studied the program's effects on rice farming in Thailand, which are various across different farm types using the propensity score matching method to address the self-selection bias in the farm-level dataset. However, it was revealed that the program's impact on enhancing economic performance fell short of the initially anticipated levels. Overall, the program's assessment revealed an estimated enhanced farm-net direct income for engaged farms, ranging between $175.12 and $194.82 per hectare. Considering the impacts of the program based on different farm types, it becomes evident that the most substantial benefits may be reaped by small-scale farmers, with gains ranging from $404.41 to $439.85 per hectare. Conversely, midsize farms experienced more modest improvements, ranging from $139.80 to $213.36 per hectare, while large farms observed gains between $138.82 and $173.34 per hectare. This shows that the program's economic viability did not had a significant effect on farm modernization investment initiatives. Furthermore, Ferry Jie and Phatcharee Thongrattana (2009) [xiii] underscored key aspects of concern within the supply chain, which include planning and control, competitor actions, government policies, and the unpredictability of climate. This assessment aligns with

the notion that information technology is not implemented in the Thai rice industry due to the heightened uncertainty associated with planning and control. The absence of suitable IT tools leaves the industry ineffective with environmental uncertainties. In addition, Suwaphim Liamminful and Rossarin Osathanunkul (2013) [xiv] found that certain countries possess a comparative advantage in rice products. Cambodia, Laos, Thailand, and Vietnam stand out, with Vietnam holding the largest market share. Thailand, on the other hand, maintains a relatively stable market share.

Yunhe Li et al. (2015) [xv] conducted an analysis of safety assessment studies concerning Bt rice, a type of rice genetically modified with the bacterium Bacillus thuringiensis (Bt). Their findings indicated that Bt rice presents a minimal environmental risk, and Bt rice products and non-Bt control rice products are confirmed to be as safe for consumption. China has a relatively well-developed regulatory system to assess and to manage for risks of genetically modified (GM) plants; however, decisions regarding approval of commercial production have become a political issue. This has resulted in the withholding of approval for two Bt rice lines that were otherwise deemed ready for integration into the Chinese agricultural system. Chinese farmers would focus the prospect of increased yield with reduced pesticide uses and would readily adopt the production of Bt rice. The delayed commercialization of Bt rice lines can be attributed to prevailing social pressures, primarily stemming from the relatively limited understanding and acceptance of genetically modified (GM) crops among Chinese consumers.

David Dawe et al. (2004) [xvi] elaborated on the decline in the area devoted to rice-wheat rotation in recent years. The combined estimate for the rice-wheat area in China in the year 2001 was 3.4 (Mha). This area size falls significantly below the figures presented in the existing literature, which can reach as high as 13 million hectares (Mha). Understanding this estimation and the factors contributing to its declining trend over time holds crucial importance in establishing priorities within crop research and comprehending potential reactions from farmers towards emerging productivity-enhancing technologies. Similarly, Lenka Fojtikova (2018) [xvii] found that China has gradually liberalized agricultural trade in line with its WTO obligations. However, relatively high state regulation of the domestic market remains in China's product exports causing a comparative disadvantage. The existence of state trade also have a negative effect on China's comparative agricultural exports.

3. Methods

The Analytical Hierarchy Process (AHP) is used as a methodological tool to select alternatives or the arrangement of alternative priorities. To effectively establish priorities, the issues at hand need to be deconstructed into the goals of an activity, the identification of available options, and the development of criteria used to make priority selections (Figure 1: The hierarchical structure of the criteria). The questionnaires have been completed by 10 selected expert participants for the AHP assessment. These participants encompass a diverse group including traders, operators, academicians, and regulators hailing from the provinces of Guangdong, Yunnan, Fujian, and Guangxi. It's noteworthy that all of these target participants boast significant experience in the realms of international rice trading operations, agricultural international trading regulations, and the academic domain of international trading.

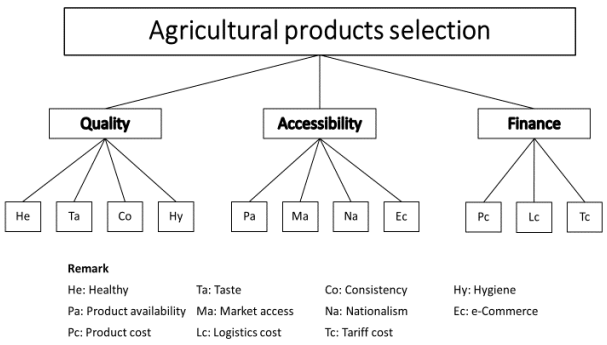

Figure 1 The hierarchical structure of the criteria

The AHP model methodology involves three primary phases such as 1.) Hierarchy structuring: In this phase, problems are organized within a hierarchical structure. The overarching goal is the selection of agricultural

products, specifically rice. The first tier of the hierarchy encompasses three criteria: quality, accessibility, and finance. The subsequent tier is defined based on primary criteria such as quality, health, taste, consistency, and hygiene. Similarly, accessibility includes product availability, market access, nationalism, and e-commerce. Lastly, the finance criterion is subdivided into components such as product cost, logistics cost, and tariff cost. 2) Priority arrangement: The second phase focuses on assigning priorities to each element within the identified problems. 3.) Rating synthesis, and consistency: The final phase involves the rating and synthesis of the data gathered during the priority arrangement stage.

4. Results

The results of AHP for rice products trading selection are shown in Tables 1 and Figure 2. The result shows that the criteria of quality are the first priority with a weight of 53.90%, this is followed by finance at 31.50% and accessibility at 14.60%.

Table 1 The results of AHP for rice products trading selection

No.	Criterion	Weights
1	Quality	53.90%
2	Finance	31.50%
3	Accessibility	14.60%

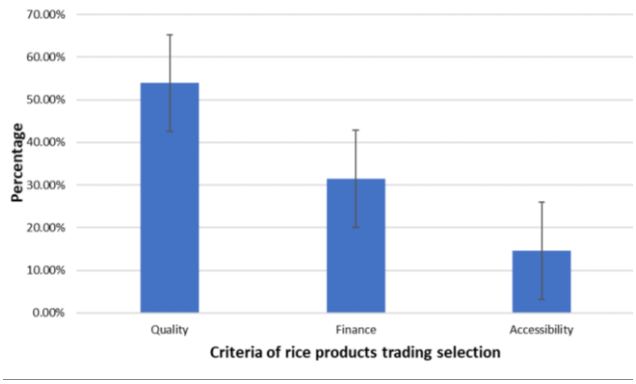

Figure 2 The results of AHP for rice products trading selection

Quality Criteria: The results of AHP for quality criteria are shown in Table 2 and Figure 3. The results show that health stands as the foremost criterion for entrepreneurs, accounting for 36.4%. The subsequent criteria include taste at 21.00%, hygiene at 34.30%, and consistency at 8.30%, respectively.

Table 2 The results of AHP for quality criterion

No.	Criteria	Weights
1	Health	36.4%
2	Taste	21.00%
3	Hygiene	34.30%
4	Consistency	8.30%

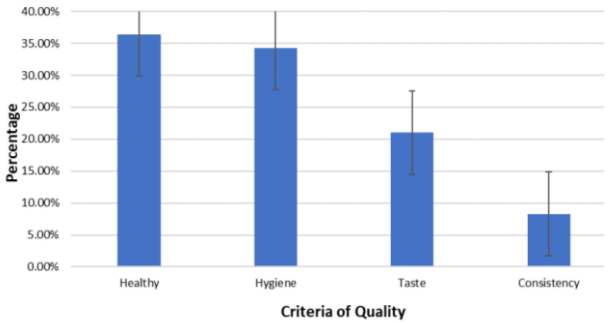

Figure 3 The results of AHP for quality criterion

Finance Criteria: The AHP results concerning the finance criterion reveal that entrepreneurs give primary importance to product cost, with a weight of 47.80%. Subsequently, the other criteria are ranked as follows: logistics cost at 34.10%, tariff cost at 10.40%, and exchange rate at 7.70%.

Table 3 The results of AHP for finance criteria

No.	Criteria	Weights
1	Product cost	47.80%
2	Logistics cost	34.10%
3	Tariff cost	10.40%
4	Exchange rate	7.70%

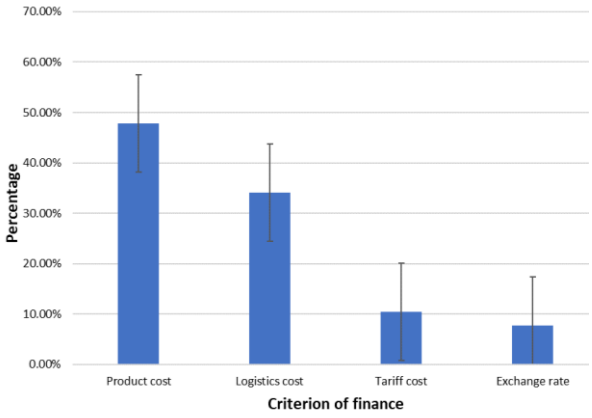

Figure 4 The results of AHP for finance criterion

Accessibility Criteria: The AHP results regarding the accessibility criterion indicate that availability holds the highest priority, with a weight of 49.00%. The subsequent significant criteria are market access at 24.40%, e-Commerce at 16.90%, and nationalism at 9.70%.

Table 4 The results of AHP for accessibility criteria

No.	Criteria	Weights
1	Availability	49.00%
2	Market access	24.40%
3	e-Commerce	16.90%
4	Nationalism	9.70%

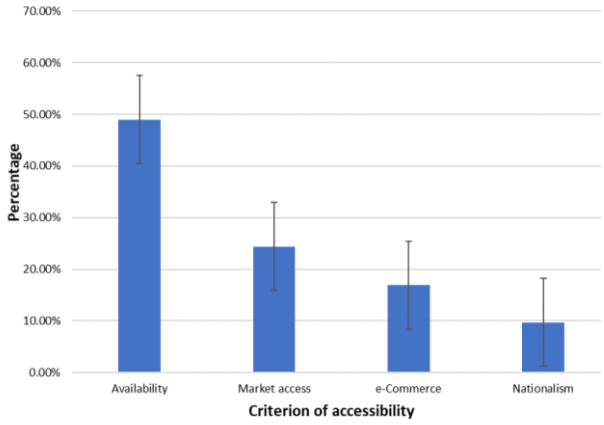

Figure 5 The results of AHP for accessibility criterion

5. Discussion

The study employs the Analytical Hierarchy Process (AHP) to determine the trade selection factors for Thai rice products within the Chinese market. The study involves 10 selected target participants, who were administered the AHP questionnaire. These participants encompass individuals from various roles including traders, operators, academicians, and regulators across the provinces of Guangdong, Yunnan, Fujian, and Guangxi. Additionally, the analysis referred to previous research particularly focused on the comparative analysis of Thai and Chinese agricultural trade studies. The study reveals that the outcomes of entrepreneur selection, as derived from the AHP analysis, are categorized into two distinct levels. The first tier involves the selection of rice products, while the second tier delves into the details and aspects of the first tier.

The empirical findings showed the most influential entrepreneur trade selection for Thai rice products in the Chinese market. Notably, the Quality factor emerges as analytically significant, accounting for a substantial 53.90%. While the most influential criterion for Quality is health at 36.4%; for finance, product cost takes the lead with 47.80%; and within the accessibility criterion, availability assumes a prominent role at 49.00%.

6. Conclutions

In the context of entrepreneur results analyzed through the AHP method, specifically concerning the selection of rice products, the outcomes emphasize that the quality criterion has the highest priority, followed by finance and accessibility, respectively. In relation to the quality criterion, the findings indicate that, according to the entrepreneur's perspective, health holds the foremost position, followed sequentially by taste, hygiene, and consistency. Regarding the finance criterion, the entrepreneur gives the highest priority to the product cost, while the remaining criteria are ranked as follows: logistics cost, tariff cost, and exchange rate, respectively. Concerning accessibility, the entrepreneur places paramount importance on availability as the primary criterion. The other significant subsequent criteria are market access, e-Commerce, and nationalism.

Acknowledgements

This paper is supported by the School of Economics, Guangxi University, Guangxi, China and the Faculty of Logistics and Digital Supply Chain, Naresuan University, Thailand. The author and co-author have no conflicts of interest to declare. The co-author has seen and agree with the contents of the manuscript. We certify that the submission is original work and is not under review at any other publication.

References

[1] [i] Orrasa Rattana-amornpirom, "The Impacts of ACFTA on Export of Thai Agricultural Products to China", Journal of ASEAN PLUS+ Studies., vol. 1, no. 1, pp:44-54, Jan-Jun 2020.
[2] [ii] *Production Calendar for Agricultural Products 2019 (Cropcalendar)*, Thailand's Department of Internal Trade, Ministry of Commerce, 2019, [Online]. Available: https://www.dit.go.th/PR_PublicationViewer.aspx?id=2200
[3] [iii] *FAOSTAT 2022*, Food and Agriculture Organization of the United Nations (FAO), 2022, [Online]. Available: https://www.fao.org/faostat/en/#compare
[4] [iv] *Rice Export Statistics*, Thai Rice Exporters Association, 2019, [Online]. Available: http://www.thairiceexporters.or.th/List_%20of_statistic.htm
[5] [v] *Production Calendar for Agricultural Products 2019 (Cropcalendar)*, Thailand's Department of Internal Trade, Ministry of Commerce, 2019, [Online]. Available: https://www.dit.go.th/PR_PublicationViewer.aspx?id=2200
[6] [vi] Prisana Suwannaporn and Anita Linnemann, "Consumer Preferences and Buying Criteria in Rice: A Study to Identify Market Strategy for Thailand Jasmine Rice Export", Journal of Food Products Marketing., vol. 14(4), pp: 33-53, Sep 2008. doi: 10.1080/10454440801986348.
[7] [vii] Jedsadaporn Sathapatyanon, et al., "The role of farmer organizations and networks in the rice supply chain in Thailand", Journal of Agribusiness in Developing and Emerging Economies., vol. 8, no. 3, pp: 554-578, Sep 2018. doi: 10.1108/JADEE-01-2017-0016.
[8] [viii] Wassanai Wattanutchariya, Roengchai Tansuchat, and Jidapah Ruennareenard, "Supply Chain Management of Thai Parboiled Rice for Export", in Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management, Kuala Lumpur, Malaysia, March 8-10, 2016, pp. 504-510
[9] [ix] Prasertwattanakul, Y. and Ongkunaruk., "The analysis of a vertically integrated organic rice company: a case study in Thailand", International Food Research Journal., vol. 25(2): pp. 481-486, April 2018.
[10] [x] *Future Thai Rice Policy from a Global Perspective: To Be or Not to Be?*, Thasanee Satimanon,
[11] School of Development Economics, National Institute of Development Administration (NIDA), 2016, [Online]. Available: https://www.tci-thaijo.org/index.php/NCRJ/article/download/59319/48814/
[12] [xi] *The Rice Situation in Thailand*, Boonjit Titapiwatanakun, Asian Development Bank, 2012, [Online]. Available: https://www.adb.org/sites/default/files/project-documents/43430-012-reg-tacr-03.pdf
[13] [xii] *Did the Thai rice-pledging program improve the economic performance and viability of rice farming?*, Witsanu Attavanich, 2015, [Online]. Available: https://www.researchgate.net/publication/285647517_Did_the_Thai_rice-pledging_programme_improve_the_economic_performance_and_viability_of_rice_farming
[14] [xiii] Phatcharee Toghaw Thongrattana, and Ferry Jie. (2009). IDENTIFYING SOURCES OF PERCEIVED ENVIRONMENTAL UNCERTAINTY ALONG THAI RICE SUPPLY CHAIN. Presented at 3rd INTERNATIONAL CONFERENCE ON OPERATIONS AND SUPPLY CHAIN MANAGEMENT. [Online]. Available: https://ro.uow.edu.au/cgi/viewcontent.cgi?article=1026&context=gsbpapers
[15] [xiv] Suwaphim Liamminful and Rossarin Osathanunkul, "ANALYSIS OF THE COMPARATIVE ADVANTAGE IN AGRICULTURAL EXPORTS OF ASEAN MEMBERS", CMU Journal of Economics., Vol. 17 No. 2 (2013)., vol. 17 no. 2, 2013. [Online]. Available: https://so01.tci-thaijo.org/index.php/CMJE/article/view/61039/50279
[16] [xv] Yunhe Li, et al., "The development and status of Bt rice in China", Plant Biotechnology Journal., vol. 14, issue. 3, pp: 839-848, Mar 2016. doi: 10.1111/pbi.12464.
[17] [xvi] David Dawe, et al., "Trends in rice–wheat area in China", Field Crops Research., vol. 87, issue. 1, pp: 89-95, Apr 2004. doi: 10.1016/j.fcr.2003.08.008.
[18] [xvii] Lenka FOJTÍKOVÁ., "China's trade competitiveness in the area of agricultural products after the implementation of the World Trade Organization commitments", CAAS Agricultural Journals – Agricultural Economics., vol. 64(9), pp: 379-388, Sep 2018. doi: 10.17221/163/2017-AGRICECON.