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Factors Influencing Off-Season Durian Production Practices for Export in Nakhon Si Thammarat Province, Thailand

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ABSTRACT

Thailand's durian sector continues to face challenges related to low production efficiency, which limits farmers' income. This is largely due to a lack of in-depth knowledge in production planning and development for export, coupled with stringent export standards imposed by trading partners. These conditions highlight the urgent need for improved production processes to ensure export-quality durian. This study aimed to investigate the factors influencing the promotion of off-season durian production for export. The research population comprised 3254 durian farming households in Tha Sala, Sichon, and Nopphitam districts of Nakhon Si Thammarat Province. A stratified random sampling method was employed to select 360 respondents. Data were analyzed using descriptive statistics and multiple regression analysis. The findings revealed that farmers' practices in off-season durian production for export were generally at a low level. The highest-rated practice was regular contact with agricultural extension officers, followed by the adoption of new technologies in production, implementation of quality assurance practices for export, participation in farmer groups to gain trade advantages, and compliance with restrictions on prohibited chemicals. Among 14 independent variables examined, five were found to have statistically significant positive relationships ($p \leq 0.05$) with farmers' production practices: export prices, household borrowing, access to production-related information, contact with government officials, and training experience in durian export production. The

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results emphasize the importance of institutional support, financial resources, and knowledge dissemination in enhancing farmers' ability to meet international export standards.

Keywords: Off-Season Durian Production; Practices; Thailand

1. Introduction

Thailand is one of the world's leading producers and exporters of durian, ranking first globally in both production and export value. In 2023, Thailand's durian exports were valued at approximately USD 1.46 billion, representing 75.22% of the global fresh durian market share^[1]. The country exported more than 530,000 t of durian in 2020, and this number has increased consistently in subsequent years, reflecting strong international demand, particularly from the People's Republic of China, Hong Kong, and neighboring Southeast Asian markets^[2]. Consequently, durian production for export has become a critical component of Thailand's agricultural economy, significantly contributing to farmers' livelihoods and national income.

Successful off-season durian production requires strict quality management across key stages, including cultivar selection, orchard management, fertilizer and agrochemical use, harvesting, and postharvest handling. These steps must adhere to internationally recognized standards such as Good Agricultural Practices (GAP) and Maximum Residue Limits (MRL)^[3]. Despite Thailand's export dominance, many farmers still lack access to modern production technologies, effective pest management, and adequate information on export requirements. These limitations directly influence production efficiency, product quality, and overall competitiveness in global markets.

Thailand has notably expanded its durian cultivation areas in recent years. By 2021, the total plantation area reached 837,290 rai, an increase of 5.83% from 2020, while total production surged by 30.72% to 1,283,593 t^[4]. The number of durian orchards in Southern Thailand has surged dramatically in recent years. The region's total area of durian orchards increased from 631,698 rai (101,072 hectares) in 2020 to 870,593 rai this year, according to the Department of Agricultural Extension, with Nakhon Si Thammarat Province lead-

ing with 39,123 durian-farming households, followed by Chumphon (29,972) and Surat Thani (18,230)^[5].

Nakhon Si Thammarat's geographical and climatic conditions are highly favorable for durian cultivation, enabling consistent production that meets both domestic and international market demands. The province's ability to produce durian year-round, especially during the off-season, enhances product value and provides significant income stability for farmers. Major off-season cultivation areas include Tha Sala (12,823 rai), Sichon (12,267 rai), and Nopphitam (10,789 rai), which collectively serve as Thailand's off-season durian production hub.

A distinctive feature of durian production in this region is the relatively even distribution of yields throughout the year, with peak output in July (22.72%) followed by December (20.09%)^[6].

Nevertheless, knowledge and technical gaps persist among local farmers. Naturally, durian flowers between March and August, when market prices tend to be low^[7]. Off-season cultivation between October and February can yield premium prices due to reduced supply and sustained consumer demand^[8]. Yet, farmers often rely heavily on chemical inputs and growth regulators, resulting in high production costs, soil degradation, and variable yields. This lack of technical understanding and appropriate management practices undermines both productivity and sustainability^[9].

Therefore, studying the processes involved in off-season durian production and identifying the factors that influence production efficiency is vital. Understanding these factors will guide policymakers and extension services in formulating effective strategies that empower Thai farmers to produce export-quality durian sustainably. This study focuses on factors influencing the promotion of off-season durian production for export, using Nakhon Si Thammarat Province as a case study. This study provides new empirical evidence on off-season durian production practices in Southern Thai-

land, a region underrepresented in the existing agricultural economics literature. It integrates institutional, economic, and informational determinants into a single analytical model, offering insights for improving export-oriented tropical fruit production.

2. Literature Review

2.1. ASEAN Fruit Export Markets

Recent developments in ASEAN fruit export markets demonstrate rapid growth driven by rising demand from China, the Middle East, and intra-ASEAN trade. Thailand, Vietnam, and Malaysia have increasingly adopted export-oriented production systems to meet stringent quality, traceability, and MRL requirements^[10, 11]. Digital certification systems, cross-border cold-chain logistics, and GAP-based auditing have become crucial for market access. These regional shifts highlight the necessity for farmers to adopt standardized off-season production practices. Therefore, promoting the stable development of agricultural commodity trade is of paramount importance for safeguarding international food security, ensuring the adequacy of agricultural product supplies, and advancing sustainable economic and social development^[12].

2.2. Digital Extension Services

Digital agriculture collects agricultural data through Internet of Things (IoT) devices—such as sensors, cameras, and agricultural machinery—which serve as tools for data acquisition. Such agricultural data are highly valuable across agro-food value chains and can be utilized in multiple domains, including health, environmental management, and research and development (R&D). Consequently, these data are in high demand among stakeholders who can leverage them for various beneficial purposes^[13]. Digital advisory platforms such as mobile-based pest alerts, online farmer networks, and IoT-linked orchard monitoring have transformed agricultural extension in tropical fruit systems. Studies in Thailand, Malaysia, and Vietnam show that farmers receiving digital advisory sup-

port demonstrate higher technology adoption, better decision-making, and improved export readiness^[14–16]. These findings underscore the importance of digitalized information access in shaping off-season durian production practices.

2.3. Climate-Smart Production and Off-Season Technologies

Climate-smart practices—including precision irrigation, microclimate monitoring, and weather-adaptive fertilization—are increasingly required for off-season tropical fruit cultivation^[17]. In ASEAN, orchards adopting climate-smart systems have reported improved flowering induction, reduced input costs, and greater consistency in off-season yield. In Thailand, off-season durian technologies now integrate growth-regulation techniques, canopy management, and controlled water-stress induction, enabling farmers to meet export windows more reliably. This demonstrates the potential of data-driven precision agriculture to enhance resource efficiency, contributing to the advancement of modern farming practices^[18]. Under these circumstances, this presents a valuable opportunity to investigate the impacts of climate variability across different regions of the country. The findings can serve as essential information and provide frameworks for strengthening, modernizing, and broadening existing technologies for quality durian production, enabling producers to effectively adapt to and cope with climate change^[19].

2.4. Durian Production in Nakhon Si Thammarat: Practices and Export Potential

Thailand's agricultural landscape is undergoing a significant transformation in 2025, with durian emerging as the crown jewel of the nation's fruit production. Nakhon Si Thammarat Province is a key durian-producing region in Thailand, with extensive cultivation and harvesting areas. In 2023, the province had 39,123 durian-farming households, the highest nationwide, covering 187,053 rai of cultivated land and 66,994 rai of harvested area, ranking second in southern Thailand^[20] (Table 1).

Table 1. Durian Production Data in Southern Thailand.

Province	Farmer Household	Area (rai)
Krabi	1060	5052.06
Chumphon	29,972	296,867.46
Trang	4830	13,454.39
Nakhon Si Thammarat*	39,123*	187,053.33*
Narathiwat	8885	29,689.42
Pattani	5313	6867.23
Phang Nga	1979	11,820.74
Phatthalung	10,819	30,619.52
Phuket	546	1740.26
Yala	7971	32,051.95
Ranong	6666	60,661.96
Songkhla	11,847	27,673.53
Satun	2688	8204.84
Surat Thani	18,230	129,195.08

Note: *1 rai = 0.16 hectares.

Source: Department of Agricultural Extension (2021).

Despite its scale, the province faces persistent production challenges, including adherence to market requirements and Good Agricultural Practices (GAP), pest and disease management, and responsible agrochemical use. Unpredictable weather patterns, such as drought and irregular rainfall during flowering and fruiting stages, reduce yields and fruit quality. Furthermore, rising input costs, including fertilizers, pesticides, and labor, erode farm profitability, often rendering returns insufficient relative to investment. Understanding these factors is essential for improving production efficiency, ensuring fruit quality, and enhancing competitiveness in global markets.

2.5. Multiple Regression Analysis

Multiple Regression Analysis is a statistical technique used to examine the relationship between a dependent variable and two or more independent variables, with the objective of developing a statistical model that can accurately predict or explain the values of the dependent variable based on the independent variables^[21]. This analysis allows for the assessment of the influence of each independent variable on the dependent variable and enables the testing of statistical significance for individual predictors using *p*-values. Additionally, the overall fitness of the model can be evaluated through various

measures^[22].

2.6. Research Objective

This study aims to examine the factors influencing farmers' practices in off-season durian production for export in Nakhon Si Thammarat Province, Thailand.

3. Materials and Methods

3.1. Population and Sampling

The population for this study consisted of durian farmers in Nakhon Si Thammarat Province, specifically in Tha Sala, Sichon, and Nopphitam Districts, which are the districts with the largest durian cultivation areas and the highest number of durian-farming households in the province (**Table 2**). A stratified random sampling method was employed, yielding a total of 3254 households, representing 8.31% of all durian-farming households in Nakhon Si Thammarat. The sample size was determined using Yamane's formula^[23] with a margin of error set at 0.05. Accordingly, the appropriate sample size was calculated as 354 durian farmers. To account for potential data errors or non-responses, the researcher collected data from 360 farmers.

Table 2. Sample Sizes by Sub-District.

District	Sub-Districts	Total Number of Households (Ni)	Number of Samples (ni)
Tha Sala	Taling Chan	811	90
	Tha Khuen	298	33
	Khlai	304	34

Table 2. Cont.

District	Sub-Districts	Total Number of Households (Ni)	Number of Samples (Ni)
Sichon	Plian	550	60
	Thep Rat	440	49
	Si Khit	298	33
Nopphitam	Krung Ching	229	25
	Nopphitam	163	18
	Na Reng	161	18
Total		3254	360

Source: Department of Agricultural Extension (2021).

3.2. Research Instruments and Data Collection

In this study, the researcher employed semi-structured interviews to collect data from the selected sample. The interview included both close-ended and open-ended questions to address the study's objectives regarding farmers' practices in off-season durian production for export in Nakhon Si Thammarat Province, Thailand. The questionnaire focused on several key aspects, including regular communication with agricultural extension officers, the transfer of technical knowledge on durian production for export, the implementation of production practices to ensure export-quality durians, participation in farmer groups to enhance trade advantages, and compliance with regulations concerning prohibited chemicals in export markets. Each item was measured using a Likert scale ranging from 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, to 5 = Very High.

The questionnaire included five domains: extension communication, export-related knowledge, adoption of production technologies, chemical-use compliance, and group participation. Content validity was ensured through expert review by three specialists in horticulture and agricultural extension. Stratified random sampling was justified based on the geographic distribution of durian orchards across the three districts, ensuring representativeness across production zones.

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Ethics Committee (Protocol No. CMUREC65/201; approval date: 28 February 2023). The researcher completed training in Human Subject Protection through the Human Research Ethics Committee of Thailand (FERCIT) on 28 July 2022.

3.3. Data Analysis

The collected data were analyzed using both descriptive and inferential statistics.

Descriptive statistics included measures such as the mean, frequency, percentage, minimum, and maximum values, which were used to describe the personal characteristics of respondents and their responses according to the Likert scale. The five-level Likert scale was interpreted as follows: 1.00–1.80 = Very Low, 1.81–2.60 = Low, 2.61–3.40 = Moderate, 3.41–4.20 = High, and 4.21–5.00 = Very High.

Inferential statistics were applied to examine the relationships between independent variables and the dependent variable. Specifically, multiple regression analysis was employed to identify the key independent variables affecting farmers' practices in off-season durian production for export.

In this study, the dependent variable was the level of farmers' practices in off-season durian production for export. The 14 independent variables included: gender, age, education level, durian production experience, farm size, product price, income from export, household borrowing, access to information on durian export production, interaction with government officers, interaction with private-sector officers, participation in training related to durian export production, participation in study visits regarding durian export production, and interaction with durian export entrepreneurs.

To ensure the robustness of the regression model, several diagnostic tests were conducted. Multicollinearity: Variance Inflation Factor (VIF) (see **Table 3**) values for all independent variables were below 5.0, indicating no multicollinearity concerns. Residual Normality: A Kolmogorov-Smirnov test and Q-Q plot assessment con-

firmed that residuals followed an approximately normal distribution. Heteroskedasticity: The Breusch–Pagan test revealed no significant heteroskedasticity ($p > 0.05$),

confirming homoscedastic residuals. Model Specification: The Ramsey RESET test supported that the linear specification was appropriate ($p > 0.05$) (**Figure 1**).

Table 3. Residuals Statistics.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	−0.3934	1.4022	0.3317	0.31158	359
Residual	−0.98570	3.61897	0.00000	0.54599	359
Std. Predicted Value	−2.327	3.436	0.000	1.000	359
Std. Residual	−1.770	6.497	0.000	0.980	359

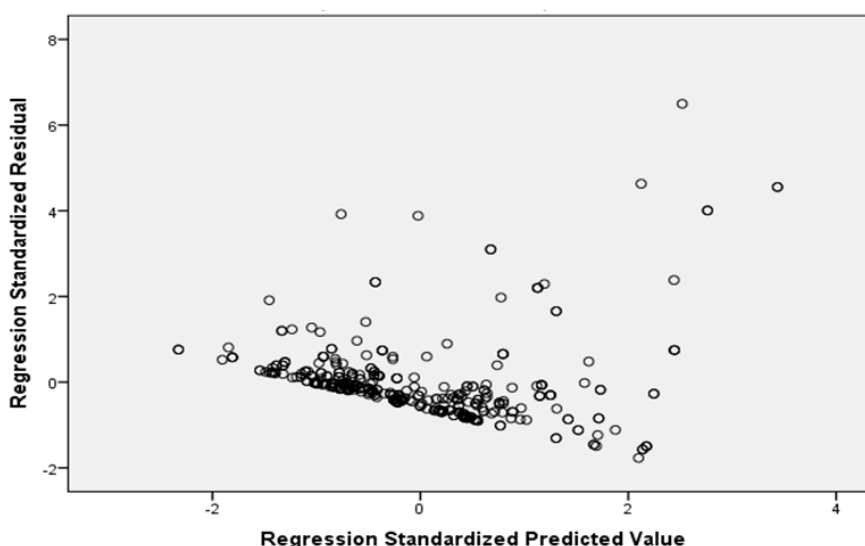


Figure 1. Heteroskedasticity.

4. Results and Discussion

4.1. General Characteristics of Farmers

Analysis of the 360 respondents revealed key descriptive statistics regarding practices in off-season durian production for export. The majority of respondents (89.4%) were male. Over half of the farmers were aged 51–60 years (31.6%), and 26.9% had completed primary education (Grade 6). More than half of the farmers had ≤ 10 years of durian production experience (69.1%), and 70% had ≤ 10 years of experience specifically in export-oriented durian production.

Regarding off-season production, 75.8% of the farmers engaged in off-season durian cultivation. Most households consisted of 2–3 members (73.6%), with 2–3 working members (66.7%). Additionally, 60.6% of farmers hired 1–5 workers. The majority (66.1%) culti-

vated durian on plots of less than 10 rai, and 51.9% had not borrowed funds from any financial sources.

In terms of information access, 40.1% of farmers obtained knowledge about off-season durian production for export from fellow farmers within the province. Interaction with government agricultural extension officers occurred 1–5 times per year for 29.4% of farmers, while more than half (61.2%) had no contact with government officers. Contact with private-sector extension officers occurred 1–5 times per year for 25.5% of farmers. Regarding training, 19.2% of farmers attended 1–5 training sessions per year on export-oriented durian production, whereas the majority (79.4%) had never participated in such training.

These observations highlight the relationships between individual-level factors and the level of farmers' production practices. The findings suggest that farmers' practical backgrounds are key factors influencing their

engagement in export-oriented durian production practices. Therefore, research aimed at developing promotion strategies can foster a deeper understanding of the motivations driving proper practices within this population. This underscores the need for tailored interventions to support sustainable export-oriented durian production.

4.2. Farmers' Level of Practice

As shown in **Table 4**, the study found that farmers engaged in off-season durian production for export

in Nakhon Si Thammarat Province exhibited overall low levels of practice across all aspects. The mean score for regular communication with agricultural extension officers was $\bar{x} = 2.01$, while the adoption of new technologies in the production process for export-oriented durian scored $\bar{x} = 1.98$. Implementation of production practices to ensure export-quality durians also had a mean score of $\bar{x} = 1.98$. Participation in farmer groups to enhance trade advantages for export yielded $\bar{x} = 1.78$, and compliance with regulations regarding prohibited chemicals in export markets was the lowest at $\bar{x} = 1.36$.

Table 4. Farmers' Level of Practice.

Aspect of Practice	$\bar{x} \pm S\bar{x}$	Level of Practice
Regular communication with agricultural extension officers	2.01 ± 1.06	Low
Adoption of new technologies in the production process for export-oriented durian	1.98 ± 1.08	Low
Implementation of production practices to ensure export-quality durians	1.98 ± 1.09	Low
Participation in farmer groups to enhance trade advantages for export	1.78 ± 1.10	Very Low
Compliance with regulations regarding prohibited chemicals in export markets	1.36 ± 0.77	Very Low

Note: 1.00–1.80 = very low; 1.81–2.60 = low; 2.61–3.40 = moderate; 3.41–4.20 = high; 4.21–5.00 = very high.

These results indicate that farmers' practices in off-season durian production for export are generally below moderate levels, highlighting significant gaps in adherence to recommended procedures and standards.

4.3. Factors Influencing Farmers' Practices in Off-Season Durian Production for Export

The study employed multiple regression analysis using the Enter method with 14 independent variables included in the regression model. The analysis revealed an F-value of 28.421 with a significance level of 0.00, indicating that the overall model was statistically significant. The multiple coefficient of determination (R^2) was 0.536, suggesting that the 14 independent variables together

explained 53.6% of the variance in the dependent variable, namely farmers' practices in promoting off-season durian production for export in Nakhon Si Thammarat Province.

Among the 14 independent variables, five variables were found to have a positive and statistically significant relationship with the dependent variable at the 0.05 level. These variables included export price, household borrowing, access to information on durian export production, contact with government agricultural extension officers, and experience in training related to durian export production.

Conversely, one variable exhibited a negative relationship with the dependent variable, which was the farmer's gender, and this relationship was also statistically significant at the 0.05 level. As summarized in **Table 5**.

Table 5. Multiple Regression Analysis of Factors Influencing Farmers' Practices in Off-Season Durian Production for Export in Nakhon Si Thammarat Province.

Variable	Regression Coefficient (b)	t	Sig.
1. Gender	-0.241	-2.238	0.026*
2. Age	0.005	1.217	0.225
3. Education level	0.007	0.941	0.347
4. Durian production experience	0.009	1.730	0.085
5. Land holding size	0.000	0.107	0.915
6. Export product prices	0.002	3.717	0.000**

Table 5. Cont.

Variable	Regression Coefficient (b)	t	Sig.
7. Income from the export of products	-5.159×10^{-9}	-0.960	0.338*
8. Loan Household	0.250	3.584	0.000**
9. Receiving information about durian production technology for export	0.266	7.056	0.000**
10. Contacting government officials	0.108	4.384	0.000**
11. Contacting private sector officials	0.000	0.021	0.983
12. Training experience in durian production for export	0.093	2.882	0.004**
13. Experience in observing durian production for export	0.116	1.352	0.177
14. Contact with durian export entrepreneurs	0.037	0.473	0.637
R = 0.732 R ² = 0.536 SEE = 0.588 F = 28.421 Sig. of F = 0.000			

Note:

* Statistically significant at the 0.01 level.

** Statistically significant at the 0.05 level.

The negative relationship between gender (male) and off-season production practices aligns with agricultural gender-role literature in Thailand. Female farmers are often more engaged in recordkeeping, quality-control tasks, and communication with extension officers—activities directly linked to export-oriented practices^[24]. Women also participate more actively in training programs and are more open to adopting new technologies, whereas men typically focus on labor-intensive fieldwork. Thus, female farmers may demonstrate higher adherence to export standards, explaining the observed negative coefficient for male farmers in the model.

4.4. Regression Equation of Factors Influencing Farmers' Practices in Off-Season Durian Production for Export

The multiple regression analysis (Table 4), the factors influencing farmers' practices in off-season durian production for export can be predicted and expressed using the following regression equation:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13} + b_{14}X_{14}$$

Where: Y = Level of practice in promoting off-season durian production for export in Nakhon Si Thammarat Province

a = Constant term, $b_1 \dots b_{14}$ = Regression coefficients representing the relationship between each independent variable and the dependent variable while controlling for all other variables in the model.

The estimated regression equation from this study is as follows:

$$Y = 0.210 - 0.241(X_1)^* + 0.005(X_2) + 0.007(X_3) + 0.009(X_4) + 0.000(X_5) + 0.002(X_6)^{**} - 5.159 \times 10^{-9}(X_7) + 0.250(X_8)^{**} + 0.266(X_9)^{**} + 0.108(X_{10})^{**} + 0.000(X_{11}) + 0.093(X_{12})^{**} + 0.116(X_{13}) + 0.037(X_{14})$$

** Significant at the 0.05 level based on the *t*-test

* Significant at the 0.01 level based on the *t*-test

The results of the multiple regression analysis indicated that the export price of durian had a positive relationship with farmers' practices in off-season durian production for export. This suggests that when farmers follow proper guidance on export-oriented durian production, they are more likely to adopt practices that ensure durian meets export quality standards and can be sold at higher prices. An increase of one unit in the durian export price corresponds to a 0.002-point increase in the score of farmers' export-oriented production practices.

Household borrowing also showed a positive relationship with off-season durian production practices. This indicates that when farmers receive guidance on credit or loans from relevant agencies, they can manage household finances effectively to support better practices in off-season durian production. An increase of one unit in household credit knowledge results in a 0.250-point increase in farmers' practice scores.

Access to information on durian export production was positively associated with farmers' practices. Farmers who received information from various sources, such

as social media (Facebook, LINE, YouTube), television, academic documents (guidelines, research papers, export production manuals), government extension officers, and fellow durian exporters, exhibited higher levels of knowledge and better implementation of export-oriented practices. Each additional source of information corresponds to a 0.266-point increase in the practice score.

Contact with government agricultural officers also had a positive effect. Farmers who maintained contact with government officers demonstrated better practices in off-season durian production than those who did not. Each additional contact corresponds to a 0.108-point increase in the practice score.

Experience in training related to durian export production was positively related to practice. Farmers who participated in training programs implemented better practices than those without such experience. Each additional training experience resulted in a 0.093-point increase in the practice score.

Conversely, gender showed a negative relationship with farmers' practices. In this study, the majority of farmers (89.4%) were male. This suggests that when promoting export-oriented durian production, female farmers may have increased opportunities to adopt appropriate practices. In other words, being male corresponds to a 0.241-point decrease in the practice score relative to female farmers, highlighting the importance of gender-sensitive interventions in training and extension programs.

Furthermore, the non-significance of variables related to private-sector contact, study visits, and interaction with exporters likely reflects the limited outreach and engagement provided by these stakeholders in Nakhon Si Thammarat Province. Unlike government extension officers, private-sector organizations and export companies in the region typically do not conduct systematic or frequent technical support activities. As a result, these channels contribute minimally to farmers' practical decision-making. This pattern is consistent with previous studies in ASEAN fruit sectors, which similarly observed that institutional and informational factors, rather than demographic characteristics, play a more decisive role in shaping farmers' production be-

havior.

5. Discussion

This study investigated the key factors influencing off-season durian production practices for export in Nakhon Si Thammarat Province, Thailand. Specifically, it examined the extent to which farmers adopt practices related to (i) communication with agricultural extension officers, (ii) the integration of new technologies in the production process, (iii) quality-oriented production practices to meet export standards, (iv) participation in farmer groups to enhance trade advantages, and (v) compliance with regulations on prohibited agrochemicals. Using a survey of 360 off-season durian growers and multiple regression analysis, the results identified five independent variables that significantly influenced farmers' off-season durian production practices for export.

The findings confirm that product price is one of the strongest motivators influencing farmers' adoption of improved production practices. High market prices act as an incentive for growers to follow standardized quality procedures, aligning their production cycles with international demand and consumer expectations. Similar findings were reported by Bente Castro Campos^[25], who found that price volatility and export competitiveness drive farmers to invest in better management practices. To develop a new theory for farmers' decision-making in adopting sustainable agricultural practices, taking into account both enabling factors and constraints from an exploratory perspective. Likewise, Wiangsamut B and Wiangsamut MEL^[26] emphasized that fruit quality management, particularly regarding ripeness, texture, and aroma, is essential for maintaining export value in the Chinese market.

Access to agricultural credit was also shown to be a significant factor, supporting farmers' ability to invest in modern inputs and orchard management. According to Meena et al.^[27], access to institutional finance directly enhances the capacity of tropical fruit growers to adopt sustainable and technology-based production systems. However, financial access must be accompanied by effective risk management training to ensure responsible

investment and prevent indebtedness among smallholders.

The study further underscores the critical role of information access in shaping farmers' production behavior. Farmers with better access to market information, technical knowledge, and export requirements were more likely to adopt recommended practices. We recommend combining market mechanisms with strengthened food control systems and boosting consumers' confidence in food control to address asymmetric information problems in emerging food markets. Similar to the findings of Akinwehinmi et al.^[28], the dissemination of agricultural information through mass media, digital platforms, and interpersonal communication significantly enhances knowledge transfer and practice adoption. Recent studies have also highlighted the growing impact of digital extension services and smart farming platforms in disseminating real-time production and weather data to fruit growers (Lee et al.^[14]; Zhang and Liu^[17]).

Moreover, interaction with agricultural extension officers was found to be a decisive factor in the adoption of export-oriented practices. Effective extension services not only facilitate technology transfer but also foster trust, continuous learning, and behavioral change among farmers. Sartepyim et al.^[24] and Olawuyi et al.^[29] similarly reported that the frequency and quality of contact between extension officers and farmers are key predictors of successful adoption of sustainable farming methods. Frequent, well-structured visits by extension personnel enhance farmers' understanding of GAP standards, pesticide safety, and recordkeeping, all of which are necessary for export certification.

Beyond the individual determinants, the study's results also highlight broader institutional and policy implications. Promoting off-season durian production requires a coordinated effort between government agencies, research institutions, and private sector stakeholders to ensure the delivery of tailored knowledge, access to technology, and continuous technical support. Integrating digital advisory systems and participatory training programs can help farmers apply data-driven approaches to orchard management, as demonstrated by Tran et al.^[16] in Vietnam's durian sector.

Furthermore, sustainability has become an increasingly important dimension of export-oriented agriculture. Lin et al.^[10] and Nguyen and Chen^[11] emphasized that international buyers are placing greater emphasis on traceability, environmental stewardship, and carbon footprint reduction. Thai durian producers who integrate sustainable practices such as water-efficient irrigation, organic fertilization, and integrated pest management are likely to gain competitive advantages and long-term market access.

Several independent variables, age, education, farm size, income from exports, private-sector contact, study visits, and entrepreneur interactions, were not statistically significant. These findings may reflect the homogeneity of durian farmers in the study region, where farmers share similar educational backgrounds, orchard sizes, and market access. Additionally, private-sector officers and exporters in the area may rarely conduct systematic outreach activities, limiting their influence. Comparable studies in ASEAN fruit sectors (Meena et al.^[27]; Harahap et al.^[7]) also found that structural and institutional factors, rather than demographic characteristics, play a stronger role in shaping farmer practices.

In conclusion, this study reinforces that institutional support, information dissemination, and training accessibility are key to improving farmers' production practices for off-season durian export. Strengthening inter-organizational collaboration among government, academic, and private sectors will enhance the technical capabilities of farmers and support Thailand's ambition to maintain its global leadership in durian exports. Future research should continue exploring how digital transformation, sustainability certification, and value-chain integration influence the long-term competitiveness of tropical fruit exports from Thailand and the broader ASEAN region.

6. Conclusion

This study identified the factors influencing off-season durian production practices for export in Nakhon Si Thammarat Province, Thailand, and proposed approaches to promote high-quality durian production. The findings provide a foundation for improving farm-

ers' off-season production practices and enhancing the capacity of production processes. In particular, the study underscores the positive influence of five key aspects: farm-gate price, household credit access, access to agricultural information, interaction with agricultural extension officers, and training on durian production.

The results highlight the need to promote practices in five critical areas: (i) communication with agricultural extension officers, (ii) integration of new technologies into the production process for export-quality durians, (iii) quality-oriented production practices to meet export standards, (iv) participation in farmer groups to enhance trade advantages, and (v) compliance with regulations on prohibited agrochemicals. Strengthening these practices among durian farmers will support sustainable production methods and enable the formulation of robust policies to advance export-oriented durian production.

These insights provide valuable guidance for policymakers, agricultural service agencies, and other stakeholders in designing targeted strategies and interventions to enhance the sustainability and efficiency of agricultural production in Thailand and beyond.

Author Contributions

J.M. contributed to designing the study, analyzed the statistical data from the study and participated in the literature searches. N.P. contributed to designing the study and supervised the entire study. J.C. contributed to the data analysis and participated in the literature searches. S.S. and N.P. contributed to analyzing the statistical data from the study. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

This study was conducted in accordance with applicable ethical guidelines for social and agricultural research involving human participants. The research de-

sign, including interview protocols and survey instruments, was reviewed and approved by the Research Institute of Chiang Mai University as part of the internal research ethics clearance process for graduate-level studies prior to fieldwork. The research team coordinated with local government agencies in Nakhon Si Thammarat Province and obtained administrative approval for data collection. All procedures were designed to minimize risk and to ensure the confidentiality of respondents' information, in full compliance with established standards for human research ethics.

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of (protocol code: CMUREC65/201; date of approval: 28 February 2023).

Informed Consent Statement

This research article was conducted with the voluntary informed consent of all study participants.

Data Availability Statement

The data supporting this study's findings are available from the corresponding author upon reasonable request (Jatupol_m@cmu.ac.th).

Conflicts of Interest

The authors declare that there is no conflict of interest concerning the publication of this manuscript.

References

- [1] Department of Trade Negotiations, 2024. Key Export Markets for Fresh Thai Durian. Ministry of Commerce of Thailand: Nonthaburi, Thailand. Available from: <https://tradereport.moc.go.th/th/stat/reportcomcodeexport04> (cited 8 April 2024). (in Thai)
- [2] Lee, L., 2022. Thai Durian to Face Challenges in 2022 Amidst Increasing Demand in China. Available from: <https://www.tridge.com/stories/thai-durian-to-face-challenges-in-2022-amidst-increasing-demand-in-china> (cited 8 April 2024).
- [3] Keawsaard, Y., 2024. Chemical Use Behavior of Farmers and the Development of Guidelines for Reducing the Use of Chemicals in Durian Produc-

- tion for Export, Karo Subdistrict, Nopphitam District, Nakhon Si Thammarat Province. *Kachasarn Science Journal*. 46(2), 19–32. DOI: <https://doi.org/10.14456/kcsj.2024.9> (in Thai)
- [4] Asia News Network, 2025. Thailand's fruit yields up in 2025; durian hits 1.6 million tonnes. Available from: <https://asianews.network/thailands-fruit-yields-up-in-2025-durian-hits-1-6-million-tonnes> (cited 8 April 2024).
- [5] Yang, W., 2025. South Thailand's durian farms raise quality to boost exports. *China Daily*. Available from: <https://www.chinadaily.com.cn/a/202509/01/WS68b54bf9a3108622abc9e39b.html> (cited 8 April 2024).
- [6] Prompinit, S., Ru-Zhue, J., Aujirapongpan, S., et al., 2025. The Risk Factors Affecting the Performance of Durian Farmers: A Case Study in Thailand. *Journal of Frontiers in Multidisciplinary Research*. 6(1), 182–189. Available from: https://www.multidisciplinaryfrontiers.com/uploads/archives/20250509193801_FMR-2025-1-106.1.pdf
- [7] Harahap, R.H., Rauf, A., Rahmawaty, et al., 2025. Adoption of Good Agricultural Practices (GAP) Among Arabica Coffee Farmers in Simalungun, Indonesia. *Research on World Agricultural Economy*. 6(4), 191–204. DOI: <https://doi.org/10.36956/rwae.v6i4.1897>
- [8] Kumar, P., Jha, A.K., Kumar, R., et al., 2025. Off-Season Vegetable Production: A Sustainable Approach for Year-Round Supply. *Agriculture & Food: E-Newsletter*. 7(12), 72413.
- [9] Pibul, P., Jawjit, S., 2021. Agrochemical Usage Inventory and Measured Residues in Streams within an Off-Season Durian Production Region of Thailand. *Frontiers in Sustainable Food Systems*. 5, 731973. DOI: <https://doi.org/10.3389/fsufs.2021.731973>
- [10] Lin, Y., Xu, H., Chen, L., 2023. Sustainable Certification and Traceability Systems for Tropical Fruit Exports in ASEAN. *Springer Nature Environment and Development Studies*. 19(2), 215–232.
- [11] Nguyen, T., Chen, Y., 2025. Environmental Standards and Market Access for Tropical Fruits: An ASEAN Perspective. *Food Policy Review*. 49(1), 67–81.
- [12] Cong, S., Chin, L., Allayarov, P., 2023. Exploring the Development of Agricultural Trade between China and ASEAN under the RCEP: A SWOT Analysis. *China WTO Review*. 9, 11–34.
- [13] Jouanjean, M.A., Casalini, F., Wiseman, L., et al., 2020. Issues around Data Governance in the Digital Transformation of Agriculture. *OECD Food, Agriculture and Fisheries Papers No. 146*. OECD Publishing: Paris, France.
- [14] Lee, H., Park, S., Kim, J., 2024. Smart Farming Applications in Tropical Fruit Production: Case Studies from Southeast Asia. *Agriculture*. 14(3), 522. DOI: <https://doi.org/10.3390/agriculture14030522>
- [15] Wong, C.K., Tan, J., Lim, P., 2024. Integrating IoT Monitoring to Improve Off-Season Fruit Yield: Lessons from Malaysia. *Journal of Agricultural Science and Technology*. 26(4), 876–889.
- [16] Tran, D.N., Nguyen, H.T., Pham, L.K., 2025. Enhancing Export Quality through Farmer Training and Digital Advisory Services: Evidence from Vietnam's Durian Industry. *Sustainability*. 17(6), 2441. DOI: <https://doi.org/10.3390/su17062441>
- [17] Xing, Y., Wang, X., 2024. Precision Agriculture and Water Conservation Strategies for Sustainable Crop Production in Arid Regions. *Plants*. 13(22), 3184. DOI: <https://doi.org/10.3390/plants13223184>
- [18] Thongnim, P., Srinil, P., 2025. Smart Farming Solutions for Durian Cultivation using IoT and Chatbot Integration for Precision Agriculture. *Discover Internet of Things*. 5, 117. Available from: <https://link.springer.com/article/10.1007/s43926-025-00227-0>
- [19] Lilavanichakul, A., Pathak, T.B., 2024. Thai Farmers' Perceptions on Climate Change: Evidence on Durian Farms in Surat Thani Province. *Climate Services*. 34, 100475. DOI: <https://doi.org/10.1016/j.cliser.2024.100475>
- [20] Holt, J., 2025. Thailand's Durian Boom: Economic Growth and Agricultural Shifts in 2025. *Broad-sheet Asia*. Available from: <https://broadsheet.asia/2025/04/15/thailands-durian-boom-economic-growth-and-agricultural-shifts-in-2025>
- [21] Hair, J.F., Anderson, R.E., Tatham, R.L., 1998. *Multivariate Data Analysis*, 5th ed. Prentice-Hall: Upper Saddle River, NJ, USA. pp. 1–730.
- [22] Gujarati, D.N., Porter, D.C., 2009. *Basic Econometrics*, 5th ed. McGraw-Hill: New York, NY, USA. pp. 1–922.
- [23] Yamane, T., 1973. *Statistics: An Introductory Analysis*, 3rd ed. Harper and Row: New York, NY, USA. pp. 1–1130.
- [24] Sartepym, S., Seerasarn, N., Keawhan, B., 2022. Factors Affecting the Participation Operations Collaborative of Mango for Farmers in Srimahaphot District, Prachinburi Province. *Journal of Roi Kaensarn Academi*. 7(9), 199–210. (in Thai)
- [25] Campos, B.C., 2022. The Rules-Boundaries-Behaviours (RBB) framework for farmers' adoption decisions of sustainable agricultural practices. *Journal of Rural Studies*. 92, 164–179.
- [26] Wiangsamut, B., Wiangsamut, M.E.L., 2023. Assessment of Natural Fruit Ripening and Fruit Quality of Three Elite Durian Cultivars for Overland Export. *Trends in Sciences*. 20(5), 4647. DOI: <https://doi.org/10.2478/2791-7913.202300005>

- i.org/10.48048/tis.2023.4647
- [27] Meena, N.K., Vinod, B.R., Menaka, M., et al., 2024. Sustainable Technologies Prospects and Potential Applications in Postharvest Storage of Fruits and Vegetables. In: Ali, S., Mir, S.A., Dar, B.N., et al. (Eds.). Sustainable Postharvest Technologies for Fruits and Vegetables, 1st ed. Boca Raton, FL, USA. pp. 42–62. DOI: <https://doi.org/10.1201/9781003370376-3>
- [28] Akinwehinmi, O., Ogundari, K., Amos, T.T., 2022. Consumers' Food Control Risk Perception and Preference for Food Safety Certification in Emerging Food Markets. *Journal of Agricultural Economics*. 73(3), 690–708. DOI: <https://doi.org/10.1111/1477-9552.12474>
- [29] Olawuyi, S.O., Ijila, O.J., Adegbite, A., et al., 2024. Smallholder Farmers' Use of Indigenous Knowledge Practices in Agri-Food Systems: Contribution of Food Security Attainment Drive. *Research on World Agricultural Economy*. 5(2), 45–67. DOI: <https://doi.org/10.36956/rwae.v5i2.1056>