Value Chain Management to Efficiency Development of Aromatic Coconut Farmers in Nakhon Pathom Province

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Abstract

This research aimed to develop the efficiency of Aromatic Coconut farmers in Nakhon Pathom Province through effective value chain management. A mixed-methods approach was employed. The quantitative component involved 400 farmers selected through stratified random sampling, using a 73-item questionnaire with a reliability coefficient of .967. Data were analyzed using descriptive statistics, t-test, ANOVA, and multiple regression. The qualitative component involved interviews with one group leader and nine experienced farmers selected via purposive sampling, analyzed using content analysis. Results showed that opinions on value chain management were at a high level, while opinions on efficiency development were at the highest level. Four key factors influencing value chain management were identified: service, infrastructure, human resource management, and procurement. The study proposed nine integrated strategies across the value chain: inbound logistics, production, outbound logistics, marketing, service, infrastructure, human resources, technology, and procurement. These approaches aim to strengthen sustainability and add value from upstream to downstream in the Aromatic Coconut industry.

Keywords: 1) Aromatic Coconut 2) Value Chain Management 3) Efficiency Development 4) Strategies

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Introduction

Thailand has placed a strong emphasis on grassroots economic development to address socio-economic disparities between urban and rural communities. A key strategic focus is the transformation of traditional production structures from a "high volume, low income" model to a "low volume, high income" paradigm, leveraging technological advancement and innovation. Among Thailand's high-potential agricultural products, aromatic coconut has shown remarkable growth in export value, with Nakhon Pathom province accounting for 11,593 rai (18,548,800 square meters) of cultivated area. (Office of Agricultural Economics, 2022). Despite this promising outlook, local farmers continue to face several structural challenges. These include inequitable pricing mechanisms driven by reliance on intermediaries, shortages of skilled labor, and inefficiencies in farm and supply chain management. Addressing these constraints is critical for sustaining the competitiveness of the sector.

This research applies Porter's (1985, p. 37) value chain framework to examine both primary and support activities within the aromatic coconut industry in Nakhon Pathom. The objective is to identify strategic points for improving operational efficiency and fostering sustainable competitive advantage for local producers. By integrating theoretical perspectives with field-based insights, the study aims to provide practical recommendations for enhancing value chain performance and promoting inclusive economic development in rural Thailand.

Value chain analysis in agriculture offers a strategic framework for enhancing productivity, market access, and sustainability among smallholder farmers. In Thailand, aromatic coconut producers in Nakhon Pathom face challenges related to fragmented production systems and limited value addition. Applying value chain principles enables stakeholders to identify inefficiencies, improve coordination, and increase economic returns. Despite its relevance, research on value chain integration in this specific context remains limited. This study seeks to address this gap by examining relevant literature and proposing a tailored approach for value chain development.

Objective(s)

1. To study the level of opinions on value chain management among aromatic coconut farmers in Nakhon Pathom Province.
2. To study the level of opinions on efficiency development factors among aromatic coconut farmers in Nakhon Pathom Province.
3. To study factors affecting value chain management for efficiency development of aromatic coconut farmers in Nakhon Pathom Province.
4. To propose guidelines for value chain management to improve the efficiency of aromatic coconut farmers in Nakhon Pathom Province.

Research Questions

1. What is the level of opinions regarding value chain management and efficiency development factors among aromatic coconut farmers in Nakhon Pathom province?
2. Which factors influence the value chain management of aromatic coconut farmers in Nakhon Pathom province, and to what extent?

3. What appropriate value chain management approaches should be implemented to enhance the efficiency of aromatic coconut farmers in Nakhon Pathom province?

Research Hypotheses

1. Different personal factors of farmers result in significant differences in value chain management of aromatic coconuts in Nakhon Pathom province.

2. Value chain management factors significantly affect the efficiency development of aromatic coconut farmers in Nakhon Pathom province.

This study proposes a value chain management model to enhance the performance of aromatic coconut farmers in Nakhon Pathom. The model illustrates causal relationships among three key elements: (1) personal factors of farmers (e.g., cultivation zone, gender, age, education, experience, labor, farm size, and yield), (2) value chain management comprising five primary and four supporting activities, and (3) performance outcomes in terms of quality, quantity, timeliness, and cost. The model addresses four research objectives, including the analysis of influencing factors and the development of practical recommendations for farmers in the region. As shown in Figure 1.

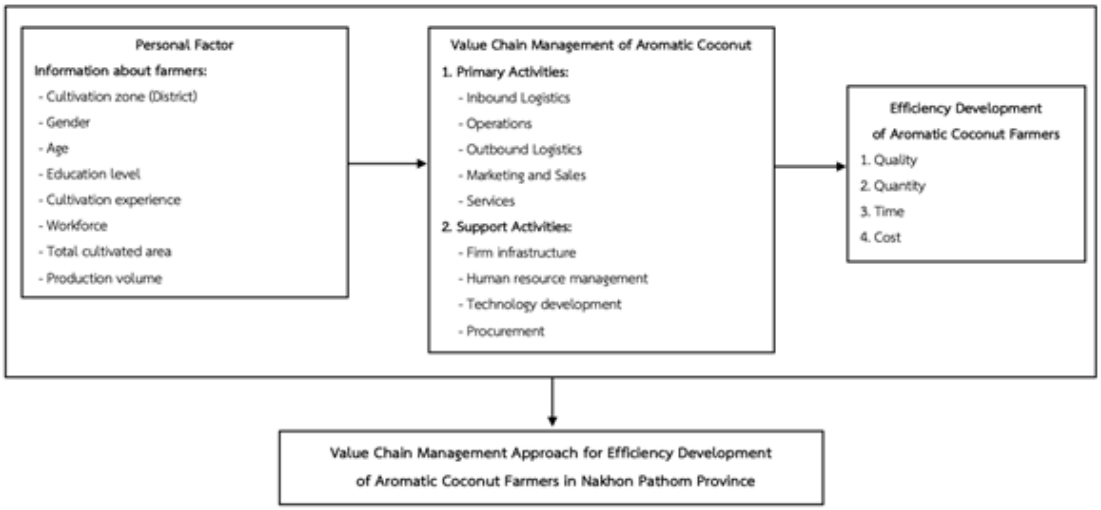

Figure 1 Research conceptual framework

Literature Review

Concepts and Theories of Value Chain Management

Value Chain Management, a concept introduced by Porter (1985, p. 37), explains the process of connecting various activities to create value for products and services, from raw material procurement to delivery to the end consumer. It consists of five primary activities: inbound logistics, operations, outbound logistics, marketing and sales, and service (Srisom, 2010, pp. 39-44). These activities operate efficiently with support from four secondary activities: organizational infrastructure, human resource management, technology development, and procurement. According to Deeseelathum (2005, p.5), value chain analysis is particularly important in the agricultural sector as it focuses on creating added value at each step, facilitating the connection of value-adding activities within operational processes. He emphasized that an organization's profit

depends on its ability to manage the linkages between all activities in the value chain, which leads to the creation of competitive business advantages.

Concepts and Theories of Efficiency Development

Efficiency refers to operational outcomes that generate satisfaction and yield profits from performance. Satisfaction, in this context, denotes the provision of satisfactory service to recipients (Millet, 1954, p. 4). The development of work efficiency constitutes the improvement and enhancement of one's or others' capabilities and skills to achieve organizational objectives. The components of efficiency development are crucial to organizational advancement. Work efficiency comprises four primary elements: Quality, which creates user satisfaction; Quantity, which aligns with organizational goals; Time, which must be appropriate and current; and Cost, which should be proportionate to outcomes. Furthermore, factors affecting organizational efficiency include organizational structure, human factors, and technological factors, as well as internal and external environmental conditions and operational processes. The development of work efficiency thus serves as a vital mechanism for organizational development to achieve success.

In summary, the theory of value chain management provides a conceptual framework for analyzing and managing primary and support activities from raw material procurement to post-sale services, with the aim of creating added value and achieving competitive advantage. In contrast, performance improvement theory focuses on enhancing operational aspects—namely quality, quantity, time, and cost—to increase both effectiveness and efficiency.

The relationship between these two theories lies in the role each plays: value chain management serves as a structural framework for organizing activities, while performance improvement acts as a mechanism to enhance the effectiveness of each activity within the value chain. Integrating these two theories within the context of aromatic coconut farmers in Nakhon Pathom Province enables efficient management of value chain activities. This integration aims to enhance product value and improve competitiveness in a sustainable manner.

Concepts and Theories of SWOT analysis

SWOT analysis is a strategic tool used to assess both internal factors (strengths and weaknesses) and external factors (opportunities and threats) to formulate appropriate strategic directions (Boonyatittan, 2010, pp. 4-6). In the context of aromatic coconut farmers in Nakhon Pathom, SWOT analysis provides a comprehensive understanding of resource potential, market opportunities, and systemic challenges. This approach facilitates the development of strategic guidelines that capitalize on strengths and opportunities while addressing weaknesses and mitigating risks, ultimately contributing to sustainable value chain improvement and enhanced competitiveness.

Information on Aromatic Coconuts in Nakhon Pathom Province

Aromatic coconut (Cocos nucifera L.) is recognized as a distinctive economic crop of

Thailand, primarily due to its sweet taste and uniquely fragrant water, which contribute to its high market value. Among the major production areas, Nakhon Pathom Province especially the districts of Sam Phran and Nakhon Chai Si have emerged as a prominent cultivation region. This is attributed to the presence of fertile clay soils and nutrient-rich alluvial sediments, which create optimal conditions for high-quality coconut farming.

The significance of the region was further reinforced when the Sam Phran Aromatic Coconut secured Geographical Indication (GI) registration in 2024. This certification highlights the unique characteristics of the local variety, known as "Moo Si," which is typified by its tall stature, monkey-head shape, tripartite base, greenish-yellow epicarp, and pandan-like aromatic water (Department of Intellectual Property, 2024, pp. 7-8). As of 2023, the area comprised approximately 2,519 farming households engaged in the cultivation of 13,672.99 rai (21,876,784 square meters), underscoring its economic and social relevance within the province.

Previous studies and agricultural reports have highlighted the high demand for aromatic coconuts in both domestic and international markets, especially within Asia and the Middle East. Despite this strong market potential, local producers continue to face challenges, including intensified market competition, climate variability, and increasing pressure to meet international quality and safety standards. These issues have prompted calls for integrated support both technical and policy oriented from government agencies and related institutional stakeholders to ensure sustainability and long-term competitiveness of the industry.

Moreover, the GI registration is seen not only as a certification of quality but also as a strategic tool for local economic empowerment and sustainable agricultural practices. It provides opportunities for branding, value-added product development, and enhanced consumer trust, all of which can further stimulate rural development and environmental stewardship in the region.

Methods

Population and Sample

The study focused on aromatic coconut growers in Nakhon Pathom Province who formally registered with the Provincial Agricultural Office during the 2023 season. This target population encompassed 2,519 registered farmers (Department of Agricultural Extension Nakhon Pathom, 2023, p.21)

For the quantitative component, researchers surveyed 400 aromatic coconut farmers throughout Nakhon Pathom. While Krejcie and Morgan's (1970, pp. 607-608) formula initially suggested 334 participants would suffice, the research team deliberately expanded this figure to 400 to minimize sampling errors and strengthen the statistical validity of findings. Participant selection followed stratified sampling protocols proportionate to the distribution of registered aromatic coconut farmers across districts within Nakhon Pathom Province.

The qualitative investigation involved in-depth engagement with ten carefully select-

ed individuals: the chairperson who oversees the large-scale aromatic coconut farming collective in Nakhon Pathom, alongside nine experienced growers who each maintain at least 3 rai (4,800 square meters) of active cultivation and possess a minimum five-year history in aromatic coconut production. These participants were identified through purposive sampling techniques to ensure rich, experiential insights into the investigated phenomena.

Research Instruments

Quantitative Research: Questionnaires were employed as data collection instruments in the quantitative phase. The questionnaire was structured into four distinct sections: Section 1 gathered respondents' demographic information; Section 2 collected data related to value chain management; Section 3 focused on efficiency development aspects; and Section 4 provided space for open-ended suggestions and recommendations.

Qualitative Research: Semi-structured interviews served as the primary data collection method for the qualitative phase. This approach utilized a flexible interview guide with predetermined themes while allowing the researcher to explore emerging topics during the interview process. The interview protocol facilitated in-depth exploration of participants' perspectives and experiences related to the research objectives.

Data Collection

Prior to commencing data collection, the researcher submitted the research proposal for human ethics review. This study received ethical approval on August 20, 2024, with certification number 025/2024. Following approval, the data collection process was initiated.

Quantitative Data Collection: Quantitative data were collected from registered aromatic coconut farmers in Nakhon Pathom Province through a structured questionnaire. Content validity was verified by three experts in value chain and efficiency development. All 64 items demonstrated full alignment with the research objectives, framework, and variable definitions, achieving an IOC score of 1.0. Expert suggestions were incorporated to improve item clarity and ensure relevance to the study.

Qualitative Data Collection: The qualitative component employed in-depth interviews as the primary data collection method. These interviews allowed for thorough exploration of participants' experiences and perspectives, providing rich contextual data that complemented the quantitative findings.

Data Analysis Methodology

The research employed a mixed-methods approach to comprehensively examine value chain management and efficiency development among aromatic coconut farmers in Nakhon Pathom Province.

Quantitative Analysis: Statistical analysis of quantitative data involved percentage calculations, means, and standard deviations. Comparative analyses of value chain management and efficiency development perceptions were conducted based on demographic factors using t-test and One-Way ANOVA. Furthermore, the relationship between value chain management factors and efficiency development was examined through multiple regression analysis

using the Enter method. This analytical framework enabled the identification of significant variables influencing agricultural efficiency outcomes.

Qualitative Analysis: This qualitative investigation examines documented materials and data obtained through interviews, observations, and field notes collected from sample groups. The gathered information was categorized into thematic issues, followed by synthesis and analysis of value chain management and efficiency development among aromatic coconut farmers in Nakhon Pathom province. Research findings were presented through descriptive analytics, whereby systematically analyzed data contributed to formulating recommendations for value chain management approaches aimed at enhancing the operational efficiency of aromatic coconut cultivators in Nakhon Pathom province.

The SWOT analysis of the environmental context and potential of aromatic coconut farming in Nakhon Pathom province reveals key strengths, weaknesses, opportunities, and threats within the value chain management system. These findings provide a comprehensive overview of the internal and external factors influencing farmers' performance. Based on this analysis, strategic approaches were developed to address challenges and enhance efficiency across the value chain. The proposed Value Chain Management Approach for Efficiency Development focuses on optimizing resource use, strengthening market access, reducing operational gaps, and supporting sustainable practices tailored to the local agricultural context.

Results

This study employs a mixed-methods research approach and is divided into three distinct sections as follows:

Section 1: Quantitative Research Findings

Part 1: Analysis of Respondents' General Demographic Data. The analysis of respondents' general demographic data utilized descriptive statistics, including frequency counts and percentage distributions. The findings revealed that most respondents had Cultivation zones in Sam Phran District, accounting for 63.00% of the sample. Most respondents were male, representing 56.25%. The predominant age group was 41–50 years, comprising 32.00% of respondents. Regarding educational background, the majority had completed secondary education or an equivalent qualification, accounting for 51.75%. In terms of agricultural experience, most respondents had approximately 6–10 years of experience in aromatic coconut cultivation, representing 37.75% of the sample. Labor force analysis indicated that the majority employed approximately 1–5 workers in their cultivation operations, accounting for 52.75%. Regarding Cultivation zone, most respondents operated on less than 11 rai of aromatic coconut plantation land, comprising 60.25%. Finally, analysis of annual production volume showed that the largest proportion of respondents produced approximately 1–10 tons per year, constituting 43.75% of the sample.

Part 2: Analysis of Opinion Levels on Value Chain Management and Performance Development of Aromatic Coconut Farmers. The analysis of respondents' opinions regard-

ing value chain management and performance development among aromatic coconut farmers was conducted using descriptive statistics, including the calculation of means and standard deviations.

Table 1 Overall Opinion on Aromatic Coconut Value Chain Management

Aromatic Coconut Value Chain Management	Level of Opinion		
	mean	S.D.	Level
Inbound Logistics	4.29	.518	Very High
Operations	4.21	.540	Very High
Outbound Logistics	4.20	.604	High
Marketing and Sales	4.02	.722	High
Services	4.17	.584	High
Firm infrastructure	4.23	.493	Very High
Human resource management	4.16	.561	High
Technology development	3.92	.766	High
Procurement	4.15	.536	High
Overall	**4.15**	**.487**	**High**

Form Table 1, the overall opinion level regarding the value chain management of aromatic coconut was at a high level (mean = 4.15). When considering each dimension in descending order of mean scores, the results were as follows: Inbound Logistics had the highest mean score (mean = 4.29), indicating a very high level of opinion. Firm Infrastructure was also rated at a very high level (mean = 4.23). Operations received a very high level of opinion as well (mean = 4.21). Outbound Logistics was rated at a high level (mean = 4.20). Services also showed a high level of opinion (mean = 4.17). Human Resource Management was at a high level (mean = 4.16). Procurement received a high level of opinion (mean = 4.15). Marketing and Sales were rated at a high level (mean = 4.02). Technology Development received the lowest mean score among the dimensions but still reflected a high level of opinion (mean = 3.92).

Table 2 Overall Opinion on Efficiency Development of Aromatic Coconut Farmers

Efficiency Development of Aromatic Coconut Farmers	Level of Opinion		
	mean	S.D.	Level
Quality	4.26	.571	Very High
Quantity	4.17	.552	High
Time	4.22	.562	Very High
Cost	4.23	.552	Very High
Overall	**4.22**	**.494**	**Very High**

Form Table 2, the overall opinion level regarding the performance development of aromatic coconut farmers was at the highest level (mean = 4.22). When considering each dimension in descending order of mean scores, the results were as follows: Quality received the highest mean score, indicating a very high level of opinion (mean = 4.26). Cost was also rated at a very high level (mean = 4.23). Time received a very high level of opinion as well (mean = 4.22). Workload had the lowest mean among the dimensions but was still rated at a high level (mean = 4.17).

Part 3: The analysis comparing factors influencing value chain management to efficiency development of aromatic coconut farmers in Nakhon Pathom Province is summarized in Table 3.

Table 3 Results of One-Way ANOVA (4 factors: cultivation zone, gender, age and education level)

Value chain management of aromatic coconut farmers	Cultivation zone		Gender		Age		Education level	
	F	Sig	t	Sig	F	Sig	F	Sig
Inbound Logistics	1.984	.067	2.321*	.021	3.280*	.006	8.966*	.000
Operations	2.571*	.019	2.608*	.009	3.154*	.008	1.868	.115
Outbound Logistics	1.401	.213	3.847*	.000	2.252*	.049	8.042*	.000
Marketing and Sales	1.391	.217	.419	.676	6.079*	.000	3.348*	.010
Services	2.085	.054	1.286	.199	1.964	.083	6.923*	.000
Firm infrastructure	1.477	.185	2.321*	.021	.451	.813	5.846*	.000
Human resource management	1.643	.134	.370	.712	1.454	.204	6.002*	.000
Technology development	1.964	.070	-.881	.379	6.081*	.000	6.694*	.000
Procurement	.774	.591	2.453*	.015	1.466	.200	4.677*	.001
Total	**2.009**	**.063**	**1.792**	**.074**	**3.165***	**.008**	**7.029***	**.000**

* Significance level at .05

From Table 3, it was found that age and education level were significantly associated with differences in farmers' opinions on the value chain management of aromatic coconuts, at the 0.05 level of statistical significance. This supports the hypothesis that different personal factors of farmers result in significant differences in value chain management of aromatic coconuts in Nakhon Pathom Province. However, planting area and gender showed no statistically significant differences.

Table 4 Results of One-Way ANOVA (4 factors: cultivation experience, workforce, total cultivated area and production volume)

Value chain management of aromatic coconut farmers	Cultivation experience		Workforce		Total cultivated area		Production volume	
	F	Sig	F	Sig	F	Sig	F	Sig
Inbound Logistics	3.014*	.030	2.121	.077	3.834*	.010	1.218	.300

Value chain management of aromatic coconut farmers	Cultivation experience		Workforce		Total cultivated area		Production volume	
	F	Sig	F	Sig	F	Sig	F	Sig
Operations	2.450	.063	3.549*	.007	1.793	.148	1.486	.193
Outbound Logistics	1.189	.314	4.482*	.001	1.085	.355	1.741	.124
Marketing and Sales	2.165	.092	3.913*	.004	2.449	.063	2.472*	.032
Services	.354	.786	2.754*	.028	2.108	.099	2.002	.077
Firm infrastructure	4.896*	.002	1.075	.369	3.164*	.025	2.095	.065
Human resource								
management	2.006	.113	1.345	.252	2.214	.086	2.054	.070
Technology development	1.477	.220	7.761*	.000	3.707*	.012	1.121	.349
Procurement	3.279*	.021	.529	.714	6.447	.000	1.681	.138
Total	**.934**	**.424**	**3.159***	**.014**	**3.203***	**.023**	**.900**	**.481**

* Significance level at .05

From Table 4, it was found that workforce and total cultivated area were significantly associated with differences in farmers' opinions on the value chain management of aromatic coconuts, at the 0.05 level of statistical significance. This supports the hypothesis that different personal factors of farmers result in significant differences in value chain management of aromatic coconuts in Nakhon Pathom Province. However, cultivation experience and production volume showed no statistically significant differences.

Part 4: Multiple regression analysis was employed to predict the dependent variable based on multiple independent variables. The correlation among the nine independent variables ranged from 0.483 to 0.759, indicating no issue of multicollinearity, as none of the correlation coefficients exceeded ±0.80 (Prasitratsinth, 2001, pp.240-247). Additionally, the Variance Inflation Factor (VIF) values for each independent variable ranged from 2.207 to 3.525, all below the threshold of 5, confirming the absence of multicollinearity. Therefore, the regression analysis was interpreted using the Enter method.

Table 5 Results of the Multiple Regression Analysis (Enter Method)

Value chain management of aromatic coconut farmers	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.493	.132		3.730	.000
Inbound Logistics (X1)	.045	.045	.047	1.000	.318
Operations (X2)	-.025	.040	-.027	-.621	.535
Outbound Logistics (X3)	-.002	.040	-.003	-.056	.955

Value chain management of aromatic coconut farmers	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Marketing and Sales (X4)	-.017	.033	-.025	-.511	.609
Services (X5)	.244	.040	.289	6.151*	.000
Firm infrastructure (X6)	.120	.050	.120	2.415*	.016
Human resource management (X7)	.181	.045	.206	4.001*	.000
Technology development (X8)	-.036	.029	-.056	-1.218	.224
Procurement (X9)	.379	.038	.411	10.106*	.000
R = .841[a] R Square = .707 Adjusted R Square = .700 Standard Error = .27026					

* Significance level at .05

The results in Table 5 show that service, firm infrastructure, human resource management, and procurement significantly influence the performance development of aromatic coconut farmers in Nakhon Pathom Province at the .05 level, supporting the research hypothesis. Conversely, inbound logistics, operations, outbound logistics, marketing and sales, and technology development were not found to have a statistically significant effect, which does not support the hypothesis.

The four significant factors service, firm infrastructure, human resource management, and procurement together account for 70.70% of the variance in farmers' opinions on performance development. In terms of relative influence, procurement had the strongest predictive power, followed by service, human resource management, and firm infrastructure, respectively.

The predictive equation in raw score form for farmers' opinions on performance development is presented as follows:

$$\hat{Y}_{tot} = 0.493 + 0.244(X_5) + 0.120(X_6) + 0.181(X_7) + 0.379(X_9)$$

$$Z = 0.493 + 0.244(X_5) + 0.120(X_6) + 0.181(X_7) + 0.379(X_9)$$

The multiple linear regression model predicts farmers' efficiency development perceptions based on procurement, service quality, human resource management, and organizational infrastructure. The intercept is 0.493, and coefficients indicate that organizational infrastructure has the greatest effect, followed by procurement, human resources, and service quality. These factors significantly influence perceptions and explain a large portion of the variance.

Section 2: SWOT Analysis of Value Chain Management for the Efficiency Development of Aromatic Coconut Farmers in Nakhon Pathom Province

This study conducted a SWOT analysis to assess value chain management to efficiency development of aromatic coconut farmers in Nakhon Pathom province, using data from both quantitative and qualitative content analysis. The key findings are summarized below.

Strengths: farmers in Nakhon Pathom Province show strengths in every stage of the

value chain, from selecting pure coconut varieties and following GAP standards to using fertile soil and drip irrigation. GPS is also used to track transportation. Their coconuts have unique qualities that support competitive pricing. They access multiple sales channels and manage operations professionally, including group purchasing and after-sales services.

Weaknesses: aromatic coconut farmers in Nakhon Pathom face several weaknesses, including a lack of systematic management in storage, finance, and skilled labor. They rely heavily on natural factors and middlemen, limiting their control. Technological development, product processing, online marketing, and certification remain underdeveloped. Challenges in transport temperature control and weak bargaining power further reduce value chain efficiency.

Opportunities: Nakhon Pathom's aromatic coconut production can be improved by adopting advanced technologies like IoT, Big Data, and AI to boost efficiency and traceability. The rise of health awareness and online markets allows farmers to reach consumers directly, reducing middlemen. Collaboration between farmers, government, and research institutions can drive innovation, certification, and local standards. Proximity to Bangkok offers strategic benefits for developing distribution centers and expanding exports.

Threats: aromatic coconut production in Nakhon Pathom faces major threats from climate change and unpredictable weather, which affect production stability and increase vulnerability to pests and diseases. Labor shortages and an aging population raise production costs, while market price fluctuations and competition from lower-cost neighboring countries add pressure. Stricter export standards, high technology costs, and limited knowledge in applying modern technologies further challenge the industry's competitiveness and sustainable development.

Section 3: Strategic Approaches to Value Chain Management for the Efficiency Development of Aromatic Coconut Farmers in Nakhon Pathom Province

Based on the SWOT analysis, this study proposes a nine-dimensional strategy to strengthen strengths and opportunities while addressing weaknesses and threats in the aromatic coconut value chain of Nakhon Pathom Province. The strategy includes (1) consolidating farmer groups to enhance bargaining power and reduce input costs; (2) promoting certified organic farming; (3) optimizing transport routes; (4) developing digital platforms for direct sales; (5) building detailed customer databases; (6) establishing advisory centers for certification support; (7) preserving farmers' experiential knowledge; (8) applying advanced technologies; and (9) expanding group membership to increase collective purchasing power. These strategies aim to improve value chain efficiency and ensure sustainable development.

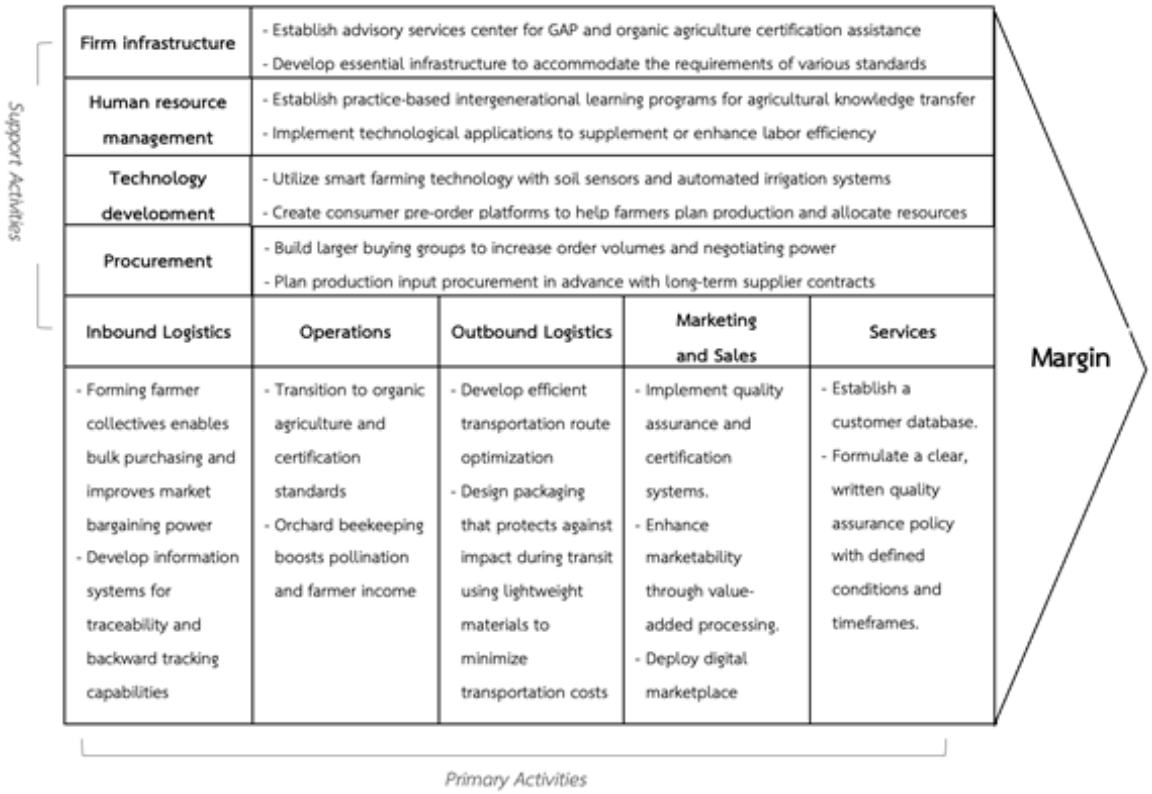

Figure 2 Value Chain Management Approach for Efficiency Development of Aromatic Coconut Farmers in Nakhon Pathom Province

Conclusion and Discussion

This study examined the value chain management and performance development factors of aromatic coconut farmers in Nakhon Pathom Province. The findings revealed that:

Research Question 1: What is the level of opinions regarding value chain management and efficiency development factors among aromatic coconut farmers in Nakhon Pathom province? Farmers' overall opinions on value chain management were at a high level, with inbound logistics, organizational infrastructure, and operations rated highest. Similarly, performance development was rated at the highest level, particularly in terms of quality, cost, time, and workload.

Research Question 2: Which factors influence the value chain management of aromatic coconut farmers in Nakhon Pathom province, and to what extent? The study identified four key factors influencing value chain management among aromatic coconut farmers in Nakhon Pathom Province. These factors include: (1) service-related support, particularly in technical assistance and marketing; (2) infrastructure, such as management systems and technology; (3) human resource management, focusing on enhancing farmers' knowledge and skills; and (4) procurement, emphasizing access to high-quality raw materials and production inputs.

Research Question 3: What appropriate value chain management approaches should be implemented to enhance the efficiency of aromatic coconut farmers in Nakhon Pathom province? Recommended strategies to

enhance farmer performance included group purchasing, organic farming, improved transport and packaging, direct marketing, customer databases, infrastructure development, intergenerational knowledge transfer, appropriate technology use, and supplier collaboration. These strategies aim to integrate the entire value chain to promote sustainability and value-added production.

Hypothesis Testing Results

This study proposed hypotheses to examine how personal factors and value chain components influence the performance of aromatic coconut farmers in Nakhon Pathom Province. The goal was to identify significant factors affecting value chain management and provide strategic recommendations to enhance farmer capacity.

H-1. Different personal factors of farmers result in significant differences in value chain management of aromatic coconuts in Nakhon Pathom province. This study examined the impact of eight personal factors on the value chain management of aromatic coconut farmers in Nakhon Pathom Province. The findings indicated that four factors supported the hypotheses, while the remaining four did not.

Factors with a Significant Impact on Value Chain Management (Supported Hypotheses) 1) Age: Older farmers tend to have more experience and a deeper understanding of production and marketing processes, resulting in more effective decision-making and management. 2) Education Level: Farmers with higher education levels are more capable of accessing information and new technologies, thereby improving both production and marketing processes. This finding aligns with the study by Suphamongkhonchai and Piyanusorn (2023, pp. 16-32), which found that age and education positively influenced competitiveness and operational success among aromatic coconut farmers in Ratchaburi Province. 3) Workforce: The availability of sufficient and skilled labor significantly enhances production efficiency and reduces costs. This is consistent with Zainol, et al. (2023, pp. 1-33), who reported that labor accounts for 34.4% of the total production cost of aromatic coconuts, highlighting its critical role in the production process. 4) Total cultivated area: Larger Cultivation zones enable higher production volumes and greater opportunities for business development. This is supported by the findings of Tanweenukul, et al. (2019, pp. 300-308), who reported that farmers in Damnoen Saduak District, Ratchaburi Province, with an average Cultivation zone of 9.97 rai, generated an average income of 52,752.24 baht per rai per year.

Factors with No Significant Impact on Value Chain Management (Unsupported Hypotheses): 1) Cultivation Zone: The geographical area within Nakhon Pathom Province showed no significant impact on value chain management, likely due to the uniformity of topographical and environmental conditions. This is consistent with the study by Junmee, et al., (2021, pp. 202-204), which reported similar results in Prachuap Khiri Khan, Chumphon, and Surat Thani Provinces. 2) Gender: The gender of the farmers had no significant effect, as men and women often share equal roles in agricultural activities across various regions. 3) Cultivation experience: While experience con-

tributes to a better understanding of production processes, it did not significantly influence value chain management. This supports the findings of Boonpen, et al., (2024, pp. 46-56), who concluded that in the context of modern agricultural operations, access to information and technology plays a more crucial role than accumulated experience. 4) Production volume: Production volume did not significantly affect value chain management. Efficient management can reduce costs and add value even with lower output. In Nakhon Pathom, the similarity in management practices is attributed to the region's historical association with aromatic coconut cultivation and the transfer of traditional knowledge, as noted by the Department of Agriculture. (2019, p. 3).

H-2. Value chain management factors significantly affect the efficiency development of aromatic coconut farmers in Nakhon Pathom province. The analysis revealed that among the nine value chain management factors examined, only four were found to have a significant effect on farmer efficiency, thereby supporting the hypothesis. The remaining five factors did not show a statistically significant relationship with efficiency.

Factors Supporting the Hypothesis (4 factors): 1) Service Activities: Service factors had a positive impact on farmer efficiency. This finding aligns with Salanan (2016, pp. 52-54), who found that operational strategies and human resource development in service processes significantly enhanced customer satisfaction and organizational performance. 2) Firm Infrastructure: Organizational infrastructure contributed significantly to efficiency development. This is consistent with findings by Meesamsen and Chienwattanasook (2021, pp. 228-241), who reported that the internal environment and role clarity within organizations positively influence operational efficiency. 3) Human Resource Management: There was a positive correlation between human resource management and efficiency. Kunworapanya and Chodhanachodti (2018, pp. 274-306) found that human resource planning, performance evaluation, workplace safety, health, and compensation policies play a critical role in enhancing performance outcomes. 4) Procurement: Procurement was significantly related to farmer efficiency. This result corresponds with the study by Phudranaang and Kanchanasuntorn (2020, pp. 1133-1144), which indicated that improving procurement processes helps reduce errors and costs and increases bargaining power with suppliers.

Factors Not Supporting the Hypothesis (5 factors): 1) Inbound Logistics: Despite its role in input procurement, inbound logistics did not significantly affect efficiency. This contradicts the findings of Sisanong, et al. (2019, p. 103), who emphasized that water management, fertilization, and pest control significantly influence yield in coconut farming. 2) Operations: Although operations are a fundamental component, they did not significantly impact efficiency. Other factors, such as quality control and marketing, appeared to be more influential. This diverges from the findings of Krisanapook, et al. (2016, p. 167), who noted that effective farm management enhances production output. 3) Outbound Logistics: Outbound logistics showed no significant effect, likely

due to the continued reliance on traditional sales channels by farmers. This aligns with the study by Chaitorn, et al. (2023, pp. 93-103), which found limited use of modern distribution networks among agricultural producers. 4) Marketing and Sales: Marketing and sales activities did not significantly influence efficiency. Most farmers lack formal marketing knowledge and still depend heavily on intermediaries. This is supported by Suriyachaipun, et al. (2023, pp. 13-26), who found that limited access to sales channels and inadequate marketing support are persistent challenges. 5) Technology Development: Technology development was not significantly related to efficiency, possibly due to a lack of alignment between available technologies and the local context or farmer capabilities. Consistent with the findings of Arumugam and Hatta (2022, p. 3414) and the study by Yu, et al. (2025, p. 1), it was found that the technologies implemented must be appropriate for the local environment and the capabilities of the farmers in the area. If the technology introduced does not align with the farmers' needs or is not user-friendly, it may result in ineffective adoption and utilization by the farmers.

This study is limited in scope to farmers cultivating aromatic coconuts in Nakhon Pathom Province, which may not fully represent the broader population in other regions. Additionally, temporal constraints and reliance on self-reported data may limit the depth and generalizability of the findings. Future research should consider expanding the geographic scope, incorporating longitudinal data, and examining the role of digital technologies and institutional stakeholders to develop more comprehensive and policy-relevant insights.

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