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The Effect of Supplier Collaboration, Transport Efficiency, Technology Adoption, and Market Demand on Distribution Efficiency and Profitability of Pumpkin Seed Supply Chain in Indonesia

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ABSTRACT

This study examines the effects of supplier collaboration, transportation efficiency, technology adoption, and market demand on the distribution efficiency and profitability of the pumpkin seed supply chain in Indonesia. Using a quantitative approach, data were collected from 150 respondents involved in the supply chain, including suppliers, distributors, and logistics providers. The data were analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS 3). The findings reveal that supplier collaboration, transportation efficiency, and technology adoption significantly enhance distribution efficiency, which in turn positively impacts profitability. Market demand was also found to moderate the relationship between distribution efficiency and profitability, particularly during periods of high demand. These findings underscore the importance of fostering collaboration, optimizing transportation, and adopting technology to improve the supply chain's operational performance and financial outcomes. The study provides valuable insights for practitioners and policymakers aiming to enhance the agricultural supply chain's competitiveness and sustainability in Indonesia.

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1. INTRODUCTION

The global agricultural supply chain has grown more complicated, with players at all levels pursuing increased operational efficiency and profitability. The pumpkin seed supply chain, which is an important element in Indonesia's agricultural economy, faces different challenges stemming from various external and internal sources [1], [2], [3]. Indonesia's efforts to increase agricultural productivity and sustainability have made improving supply chain procedures an important priority for industry and government stakeholders [4], [5]. Effective supply chain management is essential for the timely and economical delivery of agricultural products, including pumpkin seeds, from field to market [6], [7].

Recent years have seen increasing recognition of the importance of critical elements, including supplier collaboration, transit efficiency, technology adoption, and market demand, in influencing agricultural supply chain performance. Supplier collaboration denotes coordination and partnership among various participants in the supply chain, which includes farmers, distributors, and retailers [8], [9]. Efficient collaboration can reduce delays, improve communication, and optimise overall commodity logistics [10], [11]. Conversely, transport efficiency directly affects the cost and speed of product distribution, thus impacting the quality and availability of commodities in the market [12], [13], [14].

The incorporation of technology is an important element in the modernisation of agricultural supply networks [15]. Technological enhancements, including digital platforms for logistics management and real-time tracking systems, can markedly improve delivery accuracy and speed, reduce wastage, and optimise resource allocation [2], [16]. In addition to these issues, market demand forces supply chains to maintain agility and responsiveness, especially in volatile environments where consumer tastes and market conditions can change rapidly [5], [17], [18].

Despite the importance of these determinants, empirical research investigating their collective impact on distribution efficiency and profitability in pumpkin supply chains in Indonesia is still inadequate. Previous research has mostly focused on single elements, such as transport or technology adoption, although it has not comprehensively examined the synergistic effects of these factors on distribution efficiency and financial success [19], [20], [21], [22], [23], [24]. Due to the increasing demand for pumpkin seeds in local and international markets, it is imperative to understand the interaction of these variables to improve overall supply chain efficiency.

The agricultural industry is a fundamental component of the Indonesian economy, with pumpkin seeds significantly contributing to domestic consumption and export markets [21]. With the increasing consumer demand for pumpkin seeds, the need for a more efficient and profitable supply chain is crucial [25]. Inefficiencies in supply chain management, especially in terms of transport, supplier collaboration, and technology adoption, prevent producers and distributors from adequately meeting market expectations [26]. Delays, increased transportation costs, and inadequate coordination can substantially reduce revenue in competitive global markets, underscoring the urgent need for optimisation [27]. Technological innovations are revolutionising supply chains worldwide; however, Indonesia's agricultural sector [26], particularly in pumpkin seed production, has been slow to embrace these contemporary solutions, jeopardising its competitiveness [28]. Fluctuating market demand for pumpkin seeds, which relies on prompt delivery, makes improving supply chain performance critical to the industry's long-term viability and profitability [2].

The pumpkin seed supply chain in Indonesia faces significant issues that hinder distribution efficiency and profitability, stemming from four main sectors. Firstly, the absence of efficient supplier collaboration results in insufficient communication and coordination among farmers, suppliers, and distributors, leading to delays and inefficiencies that increase costs and reduce competitiveness [29]. Second, transport inefficiencies, including increased costs and logistics bottlenecks, adversely affect the timeliness and quality of deliveries, thus requiring improved transport efficiency to save costs and accelerate market access [24]. Third, inadequate adoption of technology, especially digital tools such as real-time tracking systems and supply chain management platforms, limits stakeholders' capacity to manage logistics efficiently, underscoring the need for technology integration [30]. The fickle market demand for pumpkin seeds requires a flexible supply chain capable of adapting to these fluctuations, highlighting the importance of understanding how market demand affects the correlation between distribution efficiency and profitability to improve performance [3], [31], [32]. This study aims to examine the influence of supplier collaboration, transport efficiency, technology adoption, and market demand on the distribution efficiency and profitability of pumpkin seed supply chains in Indonesia [33].

2. LITERATURE REVIEW

2.1 *Supplier Collaboration*

Supplier collaboration refers to the cooperation and coordination between stakeholders in the supply chain, such as farmers, suppliers, manufacturers, and distributors, and is essential for ensuring the seamless flow of goods, reducing delays, and improving overall supply chain efficiency. [34] emphasize that supplier collaboration significantly influences supply chain performance by fostering mutual trust, transparency, and information sharing. This collaboration helps synchronize efforts, reducing lead times, mitigating risks, and enhancing responsiveness to market demands. In agricultural supply chains, [7], [35] argue that closer collaboration improves forecasting accuracy and aligns production with demand, which is particularly relevant for pumpkin seed supply chains, where timely harvesting, processing, and distribution are critical for maintaining product quality and maximizing profits. Collaboration also leads to more efficient resource allocation through better decision-making across the supply chain. However, [14], [36] note that many agricultural sectors, particularly in developing economies like Indonesia, lack formalized collaboration frameworks, leading to inefficiencies. A collaborative approach can mitigate risks related to demand volatility and production variability, making supplier collaboration a crucial factor influencing distribution efficiency and profitability [37].

2.2 *Transportation Efficiency*

Transportation efficiency is a crucial factor in supply chain performance, significantly affecting distribution costs, delivery speed, and product quality. [35], [38] note that transportation costs can account for a large portion of total supply chain expenses, especially in geographically dispersed regions like Indonesia. Efficient transportation systems reduce costs, minimize delays, and ensure that products reach markets in optimal condition, thereby improving both distribution efficiency and profitability. In agricultural supply chains, where products like pumpkin seeds are sensitive to delays, transportation efficiency is critical. [39], [40] emphasize that transportation delays can lead to product spoilage, reduced quality, and increased costs, impacting consumer satisfaction and profitability. [39], [41], [42] highlight that optimizing transportation routes and using logistics management technology, such as real-time tracking and route optimization, can significantly improve supply chain performance by reducing fuel consumption, minimizing idle time, and enhancing delivery accuracy. Thus, transportation efficiency is directly linked to improving both distribution efficiency and profitability in agricultural supply chains.

2.3 Technology Adoption

The adoption of technology in supply chain management has greatly improved transparency, efficiency, and adaptability in agricultural supply chains. [29], [43] highlight those technologies like ERP systems and supply chain software enhance coordination and market responsiveness. For pumpkin seeds, [44], [45] note that innovations such as precision agriculture, automated inventory systems, and digital marketplaces improve tracking, demand forecasting, and resource allocation, boosting efficiency. Real-time monitoring enables data-driven decisions that reduce costs and improve distribution. However, [43], [46] points out that high costs, lack of expertise, and resistance to change hinder technology adoption, particularly in developing economies like Indonesia. Despite these challenges, technology remains crucial for enhancing supply chain efficiency and profitability.

2.4 Market Demand

Market demand plays a crucial role in shaping supply chain strategies and performance. [47], [48] highlights that understanding and responding to market demand is vital for ensuring supply chain agility and adaptability, as it affects inventory levels, production schedules, and distribution plans, all of which influence efficiency and profitability. In agricultural products like pumpkin seeds, fluctuating demand can pose challenges for consistent performance. [49], [50] stress the importance of demand forecasting and responsiveness, noting that inaccurate forecasts can lead to overproduction or underproduction, both detrimental to profitability. Overproduction increases storage costs, while underproduction causes stockouts and lost sales. In Indonesia's pumpkin seed supply chain, [49], [50], [51]argue that aligning supply chain activities with market demand is essential for optimizing distribution efficiency, ensuring products are available in the right quantities when needed. This demand-driven approach is critical for maintaining profitability and reducing waste in agricultural supply chains.

2.5 Distribution Efficiency and Profitability

Distribution efficiency measures how effectively goods are transported, stored, and delivered within a supply chain, directly influencing costs, delivery times, and customer satisfaction [52], [53]. In agricultural supply chains, where products are often perishable, distribution efficiency is critical to ensuring goods reach consumers in optimal condition. Profitability, which refers to the financial performance of the supply chain, is shaped by factors like cost management, pricing strategies, and market demand. Emphasize that minimizing costs while maximizing value creation is key to profitability. In the pumpkin seed supply chain, distribution efficiency significantly drives profitability by reducing costs and enhancing the customer experience. suggest that improving distribution efficiency results in cost reductions, faster delivery, and better product quality, all contributing to higher profitability[39], [54]. In agricultural supply chains, streamlining distribution processes is essential for maintaining a competitive edge and ensuring long-term financial success[5], [55] .

Theoretical Framework

Based on the literature reviewed, this study is grounded in the resource-based view (RBV) and dynamic capabilities theory. The resource-based view, as proposed by Barney (1991), suggests that firms can achieve a competitive advantage by utilizing valuable and rare resources, such as efficient supplier networks and advanced transportation systems. Dynamic capabilities, as outlined by Teece et al. (1997), emphasize the importance of adapting to changing market conditions through the integration of new technologies and collaboration with external partners.

Based on the literature review and theoretical framework, the following hypotheses were formulated:

H1: Supplier collaboration positively affects distribution efficiency in the pumpkin seed supply chain.

H2: Transportation efficiency positively affects distribution efficiency in the pumpkin seed supply chain.

H3: Technology adoption positively affects distribution efficiency in the pumpkin seed supply chain.

H4: Market demand moderates the relationship between distribution efficiency and profitability in the pumpkin seed supply chain.

H5: Distribution efficiency positively affects profitability in the pumpkin seed supply chain.

3. METHODS

3.1 Research Design

This study employs a quantitative research design to examine the relationships between supplier collaboration, transportation efficiency, technology adoption, market demand, distribution efficiency, and profitability in the pumpkin seed supply chain. Primary data were collected through a structured survey targeting key stakeholders, including suppliers, distributors, and retailers, with variables measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). The quantitative approach allows for statistical analysis and generalization across the population. The target population includes individuals directly involved in the pumpkin seed supply chain in Indonesia, such as farmers, suppliers, distributors, logistics providers, and retailers, offering valuable insights into supply chain efficiency and profitability. Purposive sampling was used to select 150 respondents, ensuring representation from key roles within the supply chain. This sample size is sufficient for SEM-PLS analysis, exceeding the recommended threshold of 100-200 respondents [56].

3.2 Data Collection

Data for the study were collected using a structured questionnaire designed to measure respondents' perceptions and experiences regarding supplier collaboration, transportation efficiency, technology adoption, market demand, distribution efficiency, and profitability. The questionnaire was divided into six sections, each aligned with one of the research variables, and respondents rated their agreement with various statements on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). A pre-test was conducted with a small group to ensure clarity, leading to minor adjustments in wording. The final questionnaire was distributed via email and in-person interviews, depending on the respondents' location and availability.

3.3 Data Analysis

To analyze the data and test the hypotheses, this study used Structural Equation Modeling-Partial Least Squares (SEM-PLS 3), a robust statistical technique ideal for complex models with multiple variables and small-to-medium sample sizes. SEM-PLS was selected because it allows for the simultaneous examination of multiple relationships between independent and dependent variables and can accommodate both reflective and formative measurement models [56]. The analysis involved two key steps: first, the measurement model assessment, which evaluated reliability and validity using Cronbach's alpha, composite reliability for internal consistency, and average variance extracted (AVE) for convergent validity, while discriminant validity was tested with the Fornell-Larcker criterion. Second, the structural model assessment tested the hypothesized relationships using bootstrapping with 5,000 resamples to determine the significance of the path coefficients via t-values and p-values. The model's explanatory power was measured through R-squared (R^2) values, indicating the proportion of variance explained by the independent variables

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

The descriptive statistics provide an overview of the characteristics of the sample. A total of 150 respondents participated in the study, representing various stakeholders in the pumpkin seed supply chain, including suppliers, distributors, logistics providers, and retailers. The majority of respondents (65%) were involved in distribution activities, while the remaining participants were evenly distributed between suppliers and logistics providers. Most respondents had more than 5 years of experience in the supply chain sector.

The mean scores for each variable are summarized in Table 1. The results show that respondents generally rated the level of supplier collaboration (mean = 4.12) and technology adoption (mean = 4.08) as high, indicating strong collaboration and technology use in the supply chain. Transportation efficiency (mean = 3.85) and market demand (mean = 3.92) received slightly lower ratings, suggesting moderate performance in these areas. Distribution efficiency (mean = 4.10) and profitability (mean = 4.05) were also rated highly, reflecting positive outcomes for the supply chain.

4.2 Measurement Model Assessment

To ensure the reliability and validity of the constructs in this study, we conducted several tests: Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), factor loadings, discriminant validity using both the Fornell-Larcker criterion and HTMT (Heterotrait-Monotrait Ratio). These assessments ensure that the constructs used to measure supplier collaboration, transportation efficiency, technology adoption, market demand, distribution efficiency, and profitability are reliable and valid for further analysis.

Table 1. Measurement Model Assessment

Construct	Code	Loading Factors	CA	CR	AVE
Supplier Collaboration	SC.1	0.751	0.821	0.873	0.582
	SC.2	0.787			

	SC.3	0.804			
	SC.4	0.822			
Transportation Efficiency	TE.1	0.770	0.796	0.854	0.561
	TE.2	0.797			
	TE.3	0.813			
	TE.4	0.768			
	TE.5	0.843			
Technology Adoption	TA.1	0.856	0.841	0.881	0.604
	TA.2	0.835			
	TA.3	0.822			
	TA.4	0.801			
Market Demand	MD.1	0.819	0.802	0.863	0.595
	MD.2	0.783			
	MD.3	0.817			
Distribution Efficiency	DE.1	0.835	0.815	0.883	0.615
	DE.2	0.792			
	DE.3	0.826			
	DE.4	0.834			
Profitability	PF.1	0.812	0.835	0.892	0.603
	PF.2	0.807			
	PF.3	0.795			
	PF.4	0.782			
	PF.5	0.731			

Cronbach's alpha values exceeded 0.70 for all constructs, indicating good internal consistency, while composite reliability (CR) values were also above 0.70, ensuring reliable measurement for each construct. The average variance extracted (AVE) values exceeded 0.50, confirming convergent validity, and loading factors ranged from 0.70 to 0.84, further validating the measurement model. These results demonstrate that the measurement model possesses strong reliability and validity, making it suitable for further structural analysis.

Discriminant validity was assessed using both the Fornell-Larcker criterion and the HTMT (Heterotrait-Monotrait Ratio) method. According to the Fornell-Larcker criterion, discriminant validity is established when the square root of the AVE for each construct is greater than its correlations with other constructs. Table 5 presents the square root of the AVE (in bold) alongside the inter-construct correlations, confirming the presence of discriminant validity in the measurement model.

Table 2. Fornell-Larcker Criterion

Construct	SC	TE	TA	MD	DE	PF
Supplier Collaboration	0.764					
Transportation Efficiency	0.456	0.757				
Technology Adoption	0.508	0.464	0.773			
Market Demand	0.423	0.407	0.446	0.773		
Distribution Efficiency	0.524	0.495	0.558	0.486	0.789	
Profitability	0.485	0.472	0.502	0.463	0.554	0.773

All constructs meet the Fornell-Larcker criterion, as the square roots of AVE (in bold) are greater than the correlations with other constructs. Additionally, discriminant validity was assessed using the HTMT (Heterotrait-Monotrait Ratio) method, where values below 0.90 indicate adequate discriminant validity. Table 6 presents the HTMT values, confirming that the constructs demonstrate sufficient discriminant validity.

Table 3. HTMT

Construct	SC	TE	TA	MD	DE	PF
Supplier Collaboration						
Transportation Efficiency	0.523					
Technology Adoption	0.595	0.538				
Market Demand	0.508	0.496	0.522			
Distribution Efficiency	0.613	0.584	0.644	0.567		
Profitability	0.552	0.546	0.588	0.534	0.613	

All HTMT values are below the threshold of 0.90, confirming that discriminant validity is satisfied.

The R-squared (R^2) value represents the proportion of variance in the dependent variables explained by the independent variables, with higher values indicating stronger explanatory power. The R^2 value for Distribution Efficiency is 0.676, meaning that 67.6% of the variance in distribution efficiency is explained by supplier collaboration, transportation efficiency, technology adoption, and market demand, reflecting high explanatory power. For Profitability, the R^2 value is 0.583, indicating that 58.3% of the variance is explained by distribution efficiency and market demand, representing a moderate level of explanatory power.

The Q^2 value, calculated using the blindfolding procedure, measures the predictive relevance of the model, with values greater than 0 indicating predictive relevance. For this study, the Q^2 values for Distribution Efficiency (0.43) and Profitability (0.35) are both above 0, demonstrating that the model has strong predictive relevance for these variables.

4.3 Model Fit Assessment

Model fit assessment is a critical step in evaluating how well the proposed model aligns with the collected data. In this study, several fit indices were used, including the Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI), and Chi-Square (χ^2), providing a comprehensive view of the model's adequacy. The SRMR value of 0.054 indicates a good fit, suggesting minimal differences between the observed and predicted correlations. The NFI value of 0.91 is also considered acceptable, reflecting a good fit for the complex supply chain model. Although the Chi-Square test resulted in a significant value of 312.45 with $p < 0.05$, which is expected due to the large sample size, this does not imply poor fit. Additionally, although RMSEA is not typically used in SEM-PLS models, SRMR remains the primary metric, supporting the model's validity and fit.

4.4 Structural Model Assessment

Path coefficients indicate the strength and direction of the relationships between the variables, while t-values and p-values assess the statistical significance of these relationships. A path coefficient closer to 1 represents a stronger relationship, while a t-value greater than 1.96 and a p-value less than 0.05 indicate statistical significance.

Table 4. Hypothesis Testing

Hypothesis	Original Sample	T-value	P-value
H1: Supplier Collaboration → Distribution Efficiency	0.356	4.126	0.000
H2: Transportation Efficiency → Distribution Efficiency	0.294	3.884	0.001
H3: Technology Adoption → Distribution Efficiency	0.412	5.212	0.000
H4: Market Demand → Distribution Efficiency	0.327	3.677	0.000

H5: Distribution Efficiency → Profitability	0.452	5.035	0.000
H6: Market Demand (moderating) → Profitability	0.308	3.452	0.003

The results indicate that all hypothesized relationships are positive and statistically significant, supporting each hypothesis. H1 shows that supplier collaboration positively influences distribution efficiency (β = 0.356, p 0.000), highlighting that stronger collaboration enhances distribution efficiency. H2 confirms that transportation efficiency improves distribution efficiency (β = 0.294, p 0.001), while H3 emphasizes the critical role of technology adoption in streamlining logistics and improving operations (β = 0.412, p 0.000). H4 reveals that market demand positively affects distribution efficiency (β = 0.327, p 0.000), suggesting a responsive supply chain is better able to meet market needs. H5 establishes that distribution efficiency significantly impacts profitability (β = 0.452, p 0.000), and H6 shows that market demand moderates the relationship between distribution efficiency and profitability (β = 0.308, p 0.003), underscoring the critical role of distribution efficiency in periods of high demand.

The effect size (f^2) measures the impact of each independent variable on the dependent variable. An f^2 value of 0.02 represents a small effect, 0.15 represents a medium effect, and 0.35 represents a large effect. Table 5 shows the effect size for each path.

Table 5. Effect Size

Relationship	f^2 Value
Supplier Collaboration → Distribution Efficiency	0.187
Transportation Efficiency → Distribution Efficiency	0.124
Technology Adoption → Distribution Efficiency	0.227
Market Demand → Distribution Efficiency	0.159
Distribution Efficiency → Profitability	0.282
Market Demand (moderating) → Profitability	0.175

Technology adoption has the largest effect size on distribution efficiency (f^2 = 0.227), indicating its substantial impact on improving the efficiency of distribution processes. Additionally, distribution efficiency significantly influences profitability, with an effect size of f^2 = 0.282, confirming its critical role in driving financial performance.

Discussion

The results of this study provide valuable insights into the factors that influence the distribution efficiency and profitability of the pumpkin seed supply chain in Indonesia. By examining the roles of supplier collaboration, transportation efficiency, technology adoption, and market demand, the study sheds light on how these variables interact to drive supply chain performance. The results demonstrate that supplier collaboration has a positive and significant effect on distribution efficiency, supporting H1. This aligns with previous research by[34] and [7], [34], which emphasize the role of collaboration between suppliers and stakeholders in optimizing supply chain performance. By fostering closer relationships, improving communication, and enhancing trust, collaboration allows for more efficient coordination of activities, reducing lead times, minimizing delays, and improving resource allocation. In the context of the pumpkin seed supply chain, this study underscores how stronger supplier collaboration enhances the flow of goods from producers to distributors, boosting overall distribution efficiency. This finding is especially important in agricultural supply chains, were perishability and seasonality complicate logistics, making effective coordination among supply chain actors crucial for success.

Transportation efficiency was found to positively and significantly influence distribution efficiency, supporting H2. This finding aligns with (1,2) and (3), who emphasize the critical role of transportation in ensuring timely delivery, reducing costs, and maintaining product quality in supply chains. In the pumpkin seed supply chain, transportation inefficiencies can cause delays, higher costs, and product spoilage, negatively impacting distribution efficiency. The results suggest that investing in more efficient transportation systems, such as optimizing delivery routes, improving vehicle utilization, and reducing transit times, can significantly improve the flow of goods. For agricultural products like pumpkin seeds, where freshness and quality are essential, transportation efficiency is crucial for ensuring products reach the market in optimal condition.

The study confirms that technology adoption positively and significantly impacts distribution efficiency, supporting H3. This result aligns with the findings of [34], [40], [41], who emphasize that integrating technology into supply chain management enhances coordination, improves decision-making, and streamlines operations. Technological solutions such as real-time tracking systems, automated inventory management, and data analytics enable supply chain managers to monitor the flow of goods, optimize inventory, and make data-driven decisions that enhance distribution efficiency. In the pumpkin seed supply chain, technology adoption has improved visibility and control over logistics, leading to more accurate demand forecasting, faster response times, and more efficient resource allocation. This underscores the growing importance of digital transformation in agricultural supply chains, where technology helps mitigate challenges related to distance, perishability, and market fluctuations.

Market demand significantly influences distribution efficiency and moderates the relationship between distribution efficiency and profitability, supporting H4 and H6. This aligns with the work of [47], [48], [49], who highlight the importance of demand responsiveness in supply chain management. During periods of high demand, agile and responsive supply chains ensure that products are available in the right quantities at the right time. In the pumpkin seed supply chain, demand fluctuations driven by seasonal factors and market trends require quick adjustments in production schedules, transportation routes, and inventory levels to enhance distribution efficiency and, consequently, profitability. This finding emphasizes the need for demand-driven strategies, especially in agricultural supply chains where market demand is volatile.

The study shows that distribution efficiency has a significant positive impact on profitability, supporting H5. This finding aligns with previous research by [39], [52], [53], which suggests that efficient distribution processes reduce costs, improve delivery times, and enhance customer satisfaction, ultimately leading to higher profitability. In the pumpkin seed supply chain, improvements in distribution efficiency—through better supplier collaboration, transportation optimization, or technology adoption—help reduce operational costs and boost financial performance. This significant relationship underscores the importance of operational efficiency in driving financial success. Efficient distribution not only reduces waste and costs but also enhances the ability to meet customer expectations, resulting in higher sales and revenue growth. For agricultural products like pumpkin seeds, where competition is fierce and margins tight, optimizing distribution is critical for sustaining profitability.

Theoretical Implications

The findings of this study contribute to the supply chain management literature by providing empirical evidence on the importance of supplier collaboration, transportation efficiency, technology adoption, and market demand in driving distribution efficiency and profitability. Grounded in two key theoretical frameworks—the resource-based view (RBV) and dynamic capabilities theory—the study illustrates how these elements function as strategic resources. The RBV suggests that supplier collaboration, transportation efficiency, and technology adoption serve as valuable and rare resources that allow firms to optimize their supply chains and achieve competitive advantage. Meanwhile, dynamic capabilities theory emphasizes the need for adaptability, highlighting the critical role of responding to market demand fluctuations and integrating new technologies to maintain distribution efficiency and profitability in dynamic supply chains.

Practical Implications

The study's findings have several practical implications for supply chain managers, policymakers, and industry stakeholders in the pumpkin seed supply chain:

1. Firms should invest in building strong relationships with suppliers, fostering communication and trust to improve coordination and reduce delays. Supply chain managers should implement collaborative planning and forecasting practices to enhance the overall flow of goods.
2. Optimizing transportation routes, reducing transit times, and improving vehicle utilization can significantly enhance distribution efficiency. Investment in transportation infrastructure and logistics technologies should be a priority for firms seeking to reduce costs and improve delivery performance.
3. Digital transformation is key to improving supply chain performance. Firms should adopt technologies such as real-time tracking systems, automated inventory management, and data analytics to enhance visibility and control over logistics processes.
4. Supply chains must be agile and responsive to fluctuations in market demand. Firms should develop demand-driven strategies that allow for quick adjustments to production schedules, inventory levels, and distribution routes in response to changing market conditions.

Limitations and Future Research

While the study provides valuable insights into the pumpkin seed supply chain, several limitations should be acknowledged. First, the study relies on cross-sectional data, which limits the ability to capture changes in supply chain performance over time. Future research could benefit from longitudinal studies that examine how relationships between the variables evolve in response to market changes. Second, the study focuses on the pumpkin seed supply chain in Indonesia, and the findings may not be generalizable to other agricultural products or geographic contexts. Future research could explore similar models in other sectors and regions to compare the results.

5. CONCLUSION

This study highlights the importance of supplier collaboration, transportation efficiency, technology adoption, and market demand in improving the distribution efficiency and profitability of Indonesia's pumpkin seed supply chain. The findings show that collaboration, transportation optimization, and technology integration enhance distribution efficiency, driving profitability. Market demand moderates these effects, emphasizing the need for agile supply chains. The results align with the resource-based view (RBV) and dynamic capabilities theory, suggesting that firms can gain competitive advantages by leveraging resources and adapting to market changes. For supply chain managers and policymakers, the study stresses the importance of collaboration, infrastructure investment, and technology adoption to enhance performance. While the study provides valuable insights, it acknowledges limitations, recommending future research in different regions and sectors for broader validation.

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