The Effect of Production Costs and Economies of Scale on Net Profit and Production Capacity of Small and Medium Enterprises Processing Palm Oil in South Sulawesi

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ABSTRACT

This study examines the effect of production costs and scale efficiency on the net profit and production capacity of small and medium-sized palm oil processing businesses in South Sulawesi. Using a quantitative research design, data were collected from 150 respondents and analyzed with the Structural Equation Modeling–Partial Least Squares (SEM-PLS) approach. The results show that production costs have a significant negative effect on net profit but do not significantly influence production capacity. Conversely, scale efficiency has a significant positive effect on both net profit and production capacity. Furthermore, production capacity mediates the relationship between scale efficiency and net profit, highlighting its strategic role in enhancing financial performance. These findings emphasize the importance of cost control measures and efficiency improvement strategies for achieving sustainable growth and competitiveness in the palm oil processing sector. The study offers managerial implications for SME owners and policy recommendations to strengthen operational performance in the industry.

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1. INTRODUCTION

The palm oil industry plays a crucial role in Indonesia's economic development, particularly in rural areas where it serves as a major source of income and employment. South Sulawesi, while not as dominant as Sumatra or Kalimantan in palm oil production, has experienced notable growth in small and medium-sized enterprises (SMEs) engaged in palm oil processing, which contribute to regional economic activities by adding value to crude palm oil and related products, thereby supporting both local communities and supply chain networks. However, the sustainability and competitiveness of these businesses depend largely on their ability to manage operational costs and maintain optimal production efficiency, making these factors crucial for sustaining their role in economic development and addressing sustainability challenges. The industry is a major contributor to Indonesia's GDP, with significant fiscal earnings and employment opportunities, especially in rural areas [1], while SMEs in South Sulawesi enhance regional economic activities and support local supply chains through value addition [2]. Despite these economic benefits, sustainability challenges such as deforestation, labor issues, and land conflicts persist, affecting the long-term viability of the industry [3], and the sustainability index for smallholder plantations remains low, highlighting the need for improved practices and government intervention [3]. Technological advancements and institutional support are essential for improving production efficiency and sustainability in the palm oil sector [4], with government policies and research and development programs playing a vital role in fostering growth and addressing environmental concerns [1].

In the context of palm oil processing, production costs are a critical determinant of profitability, with expenses for raw materials, labor, energy, and maintenance directly influencing the financial performance of SMEs. High production costs can erode profit margins, particularly in competitive markets where selling prices are relatively fixed due to global commodity trends, making an in-depth understanding of cost structures and effective cost control strategies essential for improving net profit. Raw material costs, such as the price of palm fruit, constitute a major component of production expenses and require accurate estimation to determine profitability, as shown in the cost analyses of Crude Palm Oil (CPO) production at PT. Bahari Gembira Ria and PT. Sandabi Indah Lestari, where raw material costs remain a primary focus [5], [6]. Direct labor costs are another significant factor, with efficient labor management contributing to overall cost reduction [5], [6], while factory overheads, including energy and maintenance, also play an important role, where effective management can enhance profitability [5], [6]. Strategies for cost optimization include implementing robust cost management systems—such as forecasting economic indicators and optimizing production processes to maintain profitability[7]—and applying break-even analysis to set realistic sales targets and pricing strategies, as practiced by PT. Bahari Gembira Ria and PT. Sandabi Indah Lestari to ensure revenue surpasses production costs [5], [6]. Additionally, adopting technological innovations in palm oil cultivation and processing can lower costs and improve yields, as evidenced by Colombian palm oil companies [8].

Another key factor influencing business performance in the palm oil sector is scale efficiency, which reflects a firm's ability to utilize its resources optimally relative to its size of operations, leading to cost reductions through economies of scale, improved resource allocation, and streamlined production processes. For SMEs, achieving higher scale efficiency can not only enhance profitability but also expand production capacity to meet growing market demand. Economies of scale occur when the average cost of production decreases as production levels increase, which is essential for SMEs to reduce costs and improve profitability, and in the palm oil sector, this can be achieved by optimizing production technology and organizational structure [9]. However, efficiency analysis in Malaysian oleochemical enterprises indicates that scale inefficiency remains a significant challenge, often due to operations at increasing returns to scale, alongside allocative inefficiency such as under-utilization of labor relative to capital, which negatively impacts overall efficiency [10]. Enhancing manufacturing operations through lean manufacturing and advanced technologies has been shown to increase productivity and efficiency by 15% to 25%, making these strategies vital for SMEs in the palm oil sector to improve scale efficiency and fulfill market demands [11]. Furthermore, implementing strategic cost management frameworks—such as integrating advanced digital tools—can align cost strategies with organizational objectives, thereby improving operational efficiency and profitability, and ultimately supporting the achievement of optimal scale efficiency.

While previous research has examined the relationships between costs, efficiency, and profitability in manufacturing and agricultural industries, studies focusing specifically on small and medium-sized palm oil processing businesses in South Sulawesi remain limited, particularly in exploring the simultaneous impact of production costs and scale efficiency on both net profit and production capacity, as well as the mediating role of capacity in linking efficiency to profitability. Insights from related sectors underscore the importance of cost efficiency and operational excellence in improving both profitability and production capacity. Production costs have been shown to significantly influence net profit, as demonstrated in the study of PT. Permata Hijau Palm Oleo Belawan [12], and in the food and beverage manufacturing sector, where production costs, along with sales and other expenses, critically affect net sales and profitability [13]. Scale efficiency in crude palm oil production is shaped by factors such as fresh fruit bunches, labor, and machine maintenance, with inefficiencies in these areas hindering the maximization of production capacity (Sosial, 2014), while in SMEs, cost efficiency and operational excellence are essential for boosting productivity and sustainability, indirectly enhancing capacity and profitability [14]. The mediating role of production capacity is evident in cases like the rejuvenation of palm oil plantations at PT IIS, where strategic investments in capacity, supported by the positive net present value of replanting activities, highlight the long-term profitability potential of such initiatives [15].

This study aims to address these gaps by analyzing the relationships among production costs, scale efficiency, net profit, and production capacity in SMEs within South Sulawesi's palm oil processing sector, employing quantitative methods with data from 150 respondents and using Structural Equation Modeling–Partial Least Squares (SEM-PLS 3) to generate empirical insights that can guide SME owners, policymakers, and industry stakeholders in formulating strategies for operational improvement and sustainable growth. The findings are expected to contribute theoretically by expanding the literature on efficiency and profitability in agricultural processing SMEs, and practically by offering actionable recommendations to enhance cost management and resource utilization in the palm oil sector of South Sulawesi.

2. LITERATURE REVIEW

2.1 Production Costs

The relationship between production costs and production capacity in the palm oil processing industry is complex, as costs encompassing raw materials, labor, and overhead not only influence profitability by affecting the cost of goods sold and net margins but also have varying effects on production capacity. While higher production costs can sometimes indicate investments in expanding capacity—such as acquiring additional raw materials or upgrading equipment to boost output and profitability[16]—they can also constrain production in SMEs with limited resources, particularly when cost increases are not matched by proportional revenue growth [17]. Studies show that production costs significantly impact net profit, as demonstrated by research on PT. Permata Hijau Palm Oleo Belawan, which found a positive correlation between cost management efficiency and profitability [12]and in the food and beverage sector, where production, sales, and other costs strongly affect net sales and profit levels, emphasizing the need for effective cost control to maintain competitive pricing and margins [18]. Break-even analysis also plays a pivotal role in linking production costs to capacity, as illustrated by PT.

Sandabi Indah Lestari's findings that sales revenue exceeding production costs signified both profitability and efficient cost management [6].

2.2 *Scale Efficiency*

Scale efficiency in palm oil processing SMEs is crucial for optimizing resource utilization and achieving cost-effectiveness through the effective use of machinery, labor, and materials to minimize waste and reduce unit costs, thereby enhancing profitability. Empirical studies indicate that higher scale efficiency enables firms to increase output without proportionally raising costs, fostering economies of scale, improved net profit, and greater production capacity to meet market demand more effectively. As a component of overall productivity change—alongside technological and technical efficiency—scale efficiency is vital for optimizing operations to achieve better productivity outcomes [19], and in two-stage production systems, it can be decomposed into process efficiencies, emphasizing the importance of optimizing each production stage [20]. Research in the Asia-Pacific region reveals that scale inefficiency is a major source of technical inefficiency, with many small firms operating at increasing returns to scale, thus presenting opportunities for growth and efficiency enhancement [21]. Measuring scale efficiency using Data Envelopment Analysis (DEA) has proven more effective than traditional stochastic production function estimation in identifying efficient scales [22], while its relationship with technological practices remains complex—where scale increases can facilitate better technical practices, but adopting new technologies is essential for achieving meaningful scale-efficiency gains [23].

2.3 *Production Capacity*

Production capacity in palm oil processing SMEs is a critical determinant of profitability and operational efficiency, shaped by factors such as machinery capability, labor availability, and raw material supply, with improvements in capacity leading to increased sales volumes, better utilization of fixed assets, and enhanced profitability. Optimization strategies include the use of linear programming to determine optimal working hours, balancing gross revenue, production costs, and lost sales to maximize profit without diminishing returns [24], and implementing mechanization in processing to boost productivity, improve quality, and strengthen market competitiveness through refined production processes [25]. Strategic capacity planning plays a dual role in ensuring stable production levels while adapting to demand fluctuations, thus supporting both long-term stability and short-term responsiveness [26], and can be further enhanced by synthesizing milling processes with oil recovery technologies to improve extraction efficiency, provided the additional capital and operating costs are justified by potential profit gains [27]. Moreover, in the context of rising biodiesel demand, effective production and capacity planning—using approaches such as mixed integer linear programming—can align production, logistics, and facility capacity to efficiently meet future market needs [28].

H5: Production capacity has a significant positive effect on net profit.

H6: Production capacity mediates the relationship between scale efficiency and net profit.

3. METHODS

3.1 Research Design

This study employs a quantitative research design to examine the effect of production costs and scale efficiency on net profit and production capacity in small and medium-sized palm oil processing businesses in South Sulawesi. The research approach is explanatory, aiming to test the relationships among variables based on a theoretical model and empirical data. The analysis utilizes Structural Equation Modeling–Partial Least Squares (SEM-PLS) version 3 to assess both the measurement and structural models.

3.2 Population and Sample

The population of this study comprises owners and managers of small and medium-sized palm oil processing businesses operating in South Sulawesi. The sample was determined using a purposive sampling technique, focusing on respondents with at least two years of operational experience to ensure sufficient knowledge about their business operations. A total of 150 respondents participated in the study, which meets the minimum sample size requirements for SEM-PLS analysis as suggested by Hair et al. (2021).

3.3 Data Collection

Primary data were collected through a structured questionnaire distributed directly to respondents. The questionnaire was divided into sections covering demographic profiles and measurement items for each research variable. A Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to measure responses. Data collection was carried out over a two-month period to ensure a representative distribution across different regions within South Sulawesi.

3.4 Research Variables and Indicators

The study examines four main variables. Production Costs (PC) refer to operational expenses encompassing raw materials, labor, energy, and maintenance, with indicators including efficiency in raw material usage, labor cost control, energy consumption management, and maintenance or repair expenses. Scale Efficiency (SE) captures the optimal utilization of resources relative to the production scale, indicated by factors such as utilization of production facilities, achievement of economies of scale, allocation efficiency of labor and machinery, and output relative to operational size.

Production Capacity (CAP) represents the maximum output achievable under normal operating conditions, measured through indicators like output volume consistency, ability to meet market demand, machine utilization rate, and operational hours or scheduling efficiency. Net Profit (NP) reflects profitability after deducting total costs from revenue, with indicators including net margin achievement, profit growth compared to previous periods, profit stability over time, and improvement in the cost-to-revenue ratio.

3.5 Data Analysis Technique

The analysis procedure using SEM-PLS 3 consists of two main stages: the Measurement Model (Outer Model) Evaluation, which assesses the reliability and validity of the indicators through indicator reliability (outer loadings ≥ 0.7), internal consistency reliability (Composite Reliability ≥ 0.7), convergent validity (Average Variance Extracted ≥ 0.5), and discriminant validity using the Fornell–Larcker criterion and HTMT ratio; and the Structural Model (Inner Model) Evaluation, which tests the hypotheses and determines the strength of relationships between variables using path coefficients and significance levels (t-statistic ≥ 1.96, p-value ≤ 0.05), the coefficient of determination (R^2) for endogenous variables, effect size (f^2) to measure the impact of exogenous variables, and predictive relevance (Q^2) to assess model predictability. The bootstrap resampling method with 5,000 samples was applied to test the statistical significance of the hypotheses.

4. RESULTS AND DISCUSSION

4.1 Demographic Profile of Respondents

The demographic analysis provides an overview of the characteristics of the respondents, who are owners and managers of small and medium-sized palm oil processing businesses in South Sulawesi. Understanding the demographic profile helps to contextualize the research findings and ensures that the data is representative of the study population. A total of 150 respondents participated in this study. The details are as follows:

Table 1. Demographic Profile of Respondents

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	96	64.0
	Female	54	36.0
Age	25–35 years	33	22.0
	36–45 years	62	41.3
	Above 45 years	55	36.7
Business Role	Owner	87	58.0
	Manager	63	42.0
Years in Operation	2–5 years	42	28.0
	6–10 years	69	46.0
	Above 10 years	39	26.0
Business Scale	Small	83	55.3
	Medium	67	44.7

Source: Results Processing Data (2025)

The results indicate that the majority of respondents are male (64%) and fall within the 36–45 year age range (41.3%), suggesting that the industry is largely managed by individuals in their productive working years. Most respondents serve as business owners (58%), reflecting a strong representation of decision-makers in the sample. The largest group has 6–10 years of operational experience (46%), indicating a mature level of business familiarity. In terms of business size, small-scale enterprises (55.3%) slightly outnumber medium-scale ones, showing that the palm oil processing sector in South Sulawesi is still dominated by smaller operations.

4.2 Measurement Model (Outer Model) Evaluation

The measurement model was evaluated to ensure that the research constructs met the criteria for reliability and validity before proceeding to the structural model analysis. The evaluation consisted of four main steps: indicator reliability, internal consistency reliability, convergent validity, and discriminant validity.

1. Indicator Reliability

Indicator reliability was assessed by examining outer loading values for each construct indicator. All items demonstrated loadings above the minimum threshold of 0.70, indicating that each indicator explains more than 50% of the variance in the corresponding latent variable (Hair et al., 2021).

Table 2. Outer Loadings of Indicators

Construct	Indicator	Outer Loading	Result
Production Costs (PC)	PC1	0.812	Reliable
	PC2	0.794	Reliable

	PC3	0.807	Reliable
	PC4	0.821	Reliable
Scale Efficiency (SE)	SE1	0.854	Reliable
	SE2	0.836	Reliable
	SE3	0.819	Reliable
	SE4	0.845	Reliable
Production Capacity (CAP)	CAP1	0.828	Reliable
	CAP2	0.810	Reliable
	CAP3	0.834	Reliable
	CAP4	0.823	Reliable
Net Profit (NP)	NP1	0.856	Reliable
	NP2	0.844	Reliable
	NP3	0.831	Reliable
	NP4	0.862	Reliable

Source: Results Processing Data (2025)

All indicators exceeded the 0.70 threshold, confirming strong indicator reliability, with outer loading values across the four constructs—Production Costs (PC), Scale Efficiency (SE), Production Capacity (CAP), and Net Profit (NP)—ranging from 0.794 to 0.862. For the Production Costs construct, indicators PC1 to PC4 consistently show high loadings (0.794–0.821), reflecting a stable and valid measurement of cost-related factors, while the Scale Efficiency construct records very high loadings (0.819–0.854), confirming that the items effectively capture efficiency aspects in palm oil processing. The Production Capacity construct demonstrates robust reliability (0.810–0.834), indicating accurate measurement of a business's ability to produce optimally, and the Net Profit construct achieves the highest reliability range (0.831–0.862), underscoring the precision of items in representing profitability. These results affirm that all measurement indicators are valid and reliable, ensuring that each construct is well-represented for subsequent SEM-PLS analysis.

2. Internal Consistency Reliability

Internal consistency reliability, measured using Composite Reliability (CR), showed that all constructs achieved values above the 0.70 threshold, indicating satisfactory reliability, with Production Costs (PC) recording a CR of 0.884, Scale Efficiency (SE) 0.903, Production Capacity (CAP) 0.896, and Net Profit (NP) 0.915, confirming that each construct demonstrates strong internal consistency for further analysis.

3. Convergent Validity

Convergent validity, assessed through Average Variance Extracted (AVE), showed that all constructs achieved values above the 0.50 threshold, indicating that the indicators adequately represent their respective constructs, with Production Costs (PC) recording an AVE of 0.655, Scale Efficiency (SE) 0.703, Production Capacity (CAP) 0.682, and Net Profit (NP) 0.729, thereby confirming the validity of all constructs for further analysis.

4. Discriminant Validity

Discriminant validity, assessed using the Fornell–Larcker criterion and the Heterotrait–Monotrait Ratio (HTMT), was confirmed as the square root of each construct's AVE exceeded its correlations with other constructs, while all HTMT ratios were below the 0.90 threshold, further validating that each construct is distinct and well-differentiated from the others.

Table 3. Fornell–Larcker Criterion

Construct	PC	SE	CAP	NP
PC	0.809			

SE	0.521	0.839		
CAP	0.434	0.654	0.826	
NP	0.498	0.602	0.563	0.854

Source: Results Processing Data (2025)

The Fornell–Larcker criterion results confirm good discriminant validity, as the square root of the Average Variance Extracted (AVE) for each construct—shown on the diagonal—is higher than its correlations with other constructs, indicating that each is empirically distinct. For Production Costs (PC), the square root of AVE is 0.809, exceeding its correlations with SE (0.521), CAP (0.434), and NP (0.498), demonstrating clear differentiation. Scale Efficiency (SE) records a square root of AVE of 0.839, greater than its correlations with PC (0.521), CAP (0.654), and NP (0.602), confirming construct uniqueness. Production Capacity (CAP) shows a square root of AVE of 0.826, surpassing its correlations with PC (0.434), SE (0.654), and NP (0.563), ensuring it measures a distinct concept. Net Profit (NP) achieves the highest square root of AVE at 0.854, which is greater than its correlations with PC (0.498), SE (0.602), and CAP (0.563), thereby reinforcing strong discriminant validity.

Table 4. HTMT Ratios

Construct Pair	HTMT Value	Result
PC – SE	0.647	Valid (<0.90)
PC – CAP	0.612	Valid (<0.90)
PC – NP	0.683	Valid (<0.90)
SE – CAP	0.648	Valid (<0.90)
SE – NP	0.621	Valid (<0.90)
CAP – NP	0.603	Valid (<0.90)

Source: Results Processing Data (2025)

The Heterotrait–Monotrait Ratio (HTMT) results show that all construct pairs have values well below the conservative 0.90 threshold, confirming strong discriminant validity across the model, with values ranging from 0.603 (CAP–NP) to 0.683 (PC–NP). These results suggest that while the constructs are meaningfully related, they are not so highly correlated as to indicate conceptual overlap. For instance, the HTMT value between Production Costs (PC) and Scale Efficiency (SE) is 0.647, reflecting a moderate association while maintaining distinctiveness, and the value between Scale Efficiency (SE) and Net Profit (NP) is 0.621, indicating that operational efficiency is related to profit levels without implying redundancy in measurement.

4.3 Structural Model (Inner Model) Evaluation

Once the measurement model was confirmed to meet reliability and validity requirements, the structural model was evaluated to test the hypothesized relationships among the research variables. The evaluation included coefficient of determination (R^2), path coefficients and hypothesis testing, effect size (f^2), and predictive relevance (Q^2).

1. Coefficient of Determination (R^2)

The R^2 values show the proportion of variance in the endogenous variables explained by the exogenous variables in the model, with Net Profit (NP) recording an R^2 of 0.640, classified as substantial, and Production Capacity (CAP) recording an R^2 of 0.570, considered moderate (Hair et al., 2021). This indicates that the model explains 64% of the variance in net profit, demonstrating strong predictive ability, and 57% of the variance in production capacity, reflecting a moderate predictive ability.

2. Path Coefficients and Hypothesis Testing

Hypothesis testing was carried out using the bootstrapping method with 5,000 resamples, applying significance criteria of a t-statistic ≥ 1.96 to meet the 95% confidence level and a p-value ≤ 0.05 to indicate statistical significance.

Table 5. Path Coefficient Results

	Relationship	β Coefficient	t-Statistic	p-Value	Result
H1	Production Costs → Net Profit	-0.298	3.412	0.001	Supported
H2	Production Costs → Production Capacity	-0.102	1.214	0.225	Not Supported
H3	Scale Efficiency → Net Profit	0.341	4.125	0.000	Supported
H4	Scale Efficiency → Production Capacity	0.521	6.348	0.000	Supported
H5	Production Capacity → Net Profit	0.287	3.029	0.003	Supported
H6	Scale Efficiency → Production Capacity → Net Profit	0.149	2.745	0.006	Supported (Mediation)

Source: Results Processing Data (2025)

The hypothesis testing results reveal important insights into the relationships among production costs, scale efficiency, production capacity, and net profit. H1 shows that production costs have a significant negative effect on net profit (β = -0.298, t = 3.412, p = 0.001), confirming that higher costs directly reduce profitability, while H2 finds that production costs do not significantly influence production capacity (β = -0.102, t = 1.214, p = 0.225), suggesting that capacity is more dependent on operational factors than on cost levels. In contrast, H3 demonstrates that scale efficiency significantly enhances net profit (β = 0.341, t = 4.125, p < 0.001), highlighting the financial benefits of operating at optimal efficiency, and H4 confirms that scale efficiency has a strong positive impact on production capacity (β = 0.521, t = 6.348, p < 0.001), indicating that efficiency improvements directly translate into higher output potential. Moreover, H5 reveals that greater production capacity significantly boosts net profit (β = 0.287, t = 3.029, p = 0.003), underscoring the profitability advantage of expanded operational output, while H6 shows that production capacity partially mediates the relationship between scale efficiency and net profit (β = 0.149, t = 2.745, p = 0.006), meaning efficiency drives profitability both directly and indirectly through increased production capacity.

3. Effect Size (f^2)

The effect size measures the impact of each exogenous construct on the endogenous construct's R^2 value.

Table 6. f^2 Effect Sizes

Relationship	f^2	Interpretation (Cohen, 1988)
Production Costs → Net Profit	0.112	Small to Medium
Production Costs → Production Capacity	0.018	Small
Scale Efficiency → Net Profit	0.156	Medium
Scale Efficiency → Production Capacity	0.345	Large
Production Capacity → Net Profit	0.094	Small to Medium

Source: Results Processing Data (2025)

Scale efficiency emerges as the most influential factor on production capacity, with the largest effect size, underscoring its role as a strong driver of capacity growth. The effect size (f^2) analysis, based on Cohen's (1988) guidelines, reveals that the relationship between production costs and net profit has a small-to-medium effect size (f^2 = 0.112), indicating that while cost control contributes to profitability, it is not the sole determinant.

Conversely, production costs and production capacity show a very small effect size (f^2 = 0.018), reinforcing earlier findings that cost levels have minimal impact on capacity expansion. Scale efficiency and net profit exhibit a medium effect size (f^2 = 0.156), emphasizing efficiency as a moderately strong driver of profitability, while the relationship between scale efficiency and production capacity records a large effect size (f^2 = 0.345), highlighting operational efficiency as the most critical factor in boosting capacity. Lastly, production capacity and net profit show a small-to-medium effect size (f^2 = 0.094), suggesting that although increasing capacity can improve profitability, its influence is more moderate compared to the direct effect of efficiency.

4. Predictive Relevance (Q^2)

The Stone–Geisser Q^2 test, applied using the blindfolding procedure, produced values greater than 0 for all endogenous variables, indicating predictive relevance, with Net Profit (NP) recording a Q^2 of 0.412 and Production Capacity (CAP) a Q^2 of 0.367, both classified as having high predictive relevance. These results confirm that the model demonstrates strong predictive accuracy for both net profit and production capacity, underscoring its usefulness for forecasting outcomes in palm oil processing SMEs.

Discussion

The findings of this study provide valuable insights into the dynamics of production costs, scale efficiency, net profit, and production capacity in small and medium-sized palm oil processing businesses in South Sulawesi, confirming that production costs have a significant negative effect on net profit, consistent with the economic principle that higher operational costs reduce profitability margins (Kotler & Keller, 2016). In the context of palm oil processing SMEs, fluctuations in raw material prices, labor wages, and energy costs directly affect financial performance, while the insignificant relationship between production costs and production capacity suggests that these businesses maintain output levels despite cost increases, likely due to fixed market demand or contractual obligations [12]. This aligns with broader findings in the consumer goods sector, where production and operating costs significantly influence net profit—often negatively—though the effect can be moderated by factors such as inventory turnover and sales volume [29]. Interestingly, while some studies, such as on PT. Permata Hijau Palm Oleo Belawan, found a positive link between production costs and net profit due to possible revenue gains or efficiency improvements [12], other research supports the traditional view that higher costs reduce profitability [30].

Scale efficiency emerged as a crucial factor positively influencing both net profit and production capacity, supporting prior studies (Fare et al., 1994; Coelli et al., 2005) which emphasize that operational efficiency enables firms to maximize output with minimal input, thereby reducing unit production costs and increasing profitability. For palm oil SMEs, higher scale efficiency can result from improved process management, better use of machinery, and optimal workforce allocation. Implementing lean manufacturing techniques, such as the 5S philosophy and work standardization, has been shown to raise efficiency by 7% through reducing oil losses and unproductive times [31], while the use of advanced digital tools like ERP systems and AI analytics can enhance real-time decision-making, cost transparency, and resource allocation Quality operational management—including effective planning, process control, and fostering a culture of continuous improvement—also contributes to efficiency gains [32], and efficient allocation of labor and capital, influenced by factors such as education level and mechanization, is vital for achieving higher output and profit efficiency in traditional palm oil processing [33]. Furthermore, evidence from data envelopment analysis (DEA) shows that regions with high technical, allocative, cost, and scale efficiency scores tend to achieve better production outcomes, although nationwide improvements in input efficiencies remain necessary to reduce overall production costs [34].

The mediation analysis reveals that production capacity serves as a significant intermediary between scale efficiency and net profit, indicating that improvements in efficiency not only deliver direct financial gains but also indirectly enhance profitability by enabling firms to produce and sell more palm oil products. This aligns with the resource-based view (RBV) (Barney, 1991), which posits that efficient exploitation of resources improves operational outcomes and strengthens competitive advantage. RBV emphasizes two core principles: resource heterogeneity and immobility, where resources are unevenly distributed across firms and cannot be easily transferred or replicated, allowing unique advantages [35], [36], and strategic resources, where only those that are valuable, rare, inimitable, and non-substitutable (VRIN) can sustain competitive superiority [36]. Within this framework, operational efficiency—achieved through optimal resource utilization—reduces costs, increases production capacity, and thereby boosts profitability [36], [37]while efficient resource management fosters distinctive capabilities that are difficult for competitors to imitate, preserving market advantage [35], [36].

From a managerial standpoint, these findings suggest that palm oil SMEs in South Sulawesi should prioritize strategic investments in technology upgrades, workforce training, and lean production methods to achieve higher scale efficiency. Simultaneously, implementing cost-control measures such as bulk purchasing, energy efficiency programs, and improved supply chain coordination is vital to offset the negative impact of rising production costs on profitability. By integrating efficiency improvements with targeted cost management, SMEs can enhance both their operational performance and long-term competitive positioning.

5. CONCLUSION

This research provides empirical evidence on the interrelationships among production costs, scale efficiency, net profit, and production capacity in the context of small and medium-sized palm oil processing businesses in South Sulawesi. The findings show that high production costs erode profitability but do not necessarily reduce production capacity, suggesting that firms maintain output levels despite rising expenses, likely to fulfill market commitments. In contrast, scale efficiency has a dual impact, directly boosting both profitability and production capacity, while also indirectly enhancing net profit through improved capacity utilization. These results highlight the critical role of efficiency improvements in sustaining financial performance and operational capability in the palm oil sector.

From a practical perspective, palm oil SMEs should adopt integrated strategies that combine cost reduction with efficiency enhancement. Investments in technology, skilled labor, and process optimization can drive greater scale efficiency, enabling higher output without proportionally increasing costs. At the same time, effective cost control—through supplier negotiation, waste reduction, and energy efficiency—remains vital for protecting profit margins. Policymakers can strengthen these initiatives by providing affordable financing, facilitating targeted training programs, and promoting technology adoption tailored to the palm oil industry. In the long run, balancing operational efficiency with disciplined cost management will be key to sustaining competitiveness and profitability for palm oil SMEs in South Sulawesi.

REFERENCES

[1] T. Wahyono, "EKONOMI INDUSTRIKELAPA SAWIT DI INDONESIA SERTA KAITANNYA DENGAN PROGRAM PENELITIAN DAN PENGEMBANGAN," *Agro Ekon.*, vol. 15, no. 1, pp. 85–100, 2017.

[2] A. W. HIDAYAT, R. SAPUTRA, D. W. I. N. ZAHRA, and I. FAJAR, "CONTRIBUTION OF INDONESIAN OIL PALM PLANTATIONS TO SUSTAINABLE DEVELOPMENT," *Int. J. Creat. Futur. Herit.*, vol. 11, no. 1, pp. 113–123, 2023.

[3] J. Supriatna, D. Djumarno, A. B. Saluy, and D. Kurniawan, "Sustainability Analysis of Smallholder Oil Palm Plantations in Several Provinces in Indonesia," *Sustainability*, vol. 16, no. 11, p. 4383, 2024.

[4] M. Harisudin, J. Sutrisno, and H. Irianto, "A Structural Equation Modelling Approach in Assessing the Sustainability of Indonesian Smallholder Oil Palm Farming," *J. Ecohumanism*, vol. 3, no. 4, pp. 3368–3379, 2024.

[5] A. T. Subekti, "Analisis Perhitungan Harga Pokok Produksi (HPP) Dan Break Event Point (BEP) Produksi Crude Palm Oil (CPO) Pada PT. Bahari Gembira Ria," *J. Tek. Mesin dan Ind.*, vol. 3, no. 2, pp. 25–33, 2024.

[6] I. Ariyanti, B. Sumantri, S. Sriyoto, and E. Sumartono, "Cost Of Production Analysis and Break Event Point of Crude Palm Oil Production On PT. Sandabi Indah Lestari," *Agric*, vol. 30, no. 1, pp. 1–14, 2018.

[7] N. Bondarchuk and L. Vasiljeva, "Impact of operating costs on economic phenomena and the possibility of their optimization at processors," *Balt. J. Econ. Stud.*, vol. 4, no. 2, pp. 40–46, 2018.

[8] M. M. Montoya *et al.*, "Costos de producción de la agroindustria de la palma de aceite en Colombia en 2014," *Palmas*, vol. 37, no. 2, pp. 37–53, 2016.

[9] G. J. Stigler, "The economies of scale," *J. Law Econ.*, vol. 1, pp. 54–71, 1958.

[10] M. O. A. Bushara, "Economic Efficiency of Malaysian Oleochemical Enterprises." Universiti Putra Malaysia, 2001.

[11] M. C. Mudau, L. W. Moshapo, T. M. Monyela, and B. A. Thango, "The role of manufacturing operations in SMEs performance: A systematic review," 2024.

[12] J. Marbun and V. Fathimah, "Pengaruh Harga Pokok Produksi (HPP) terhadap Laba Bersih Pabrik Minyak Goreng Kemasan Tahun 2022-2023," *J. Inform. Ekon. Bisnis*, pp. 506–509, 2024.

[13] P. Kezia and E. Wulandari, "Pengaruh biaya produksi terhadap laba bersih pada perusahaan makanan dan minuman yang terdaftar di Bursa Efek Indonesia Tahun 2019-2022," in *Seminar Nasional Pariwisata Dan Kewirausahaan (SNPK)*, 2024, pp. 602–608.

[14] S. Suriani, S. M. Baharuddin, I. Nur, and H. Abubakar, "Driving cost efficiency through operational excellence and sustainability of SMEs in Barru Regency, South Sulawesi, Indonesia," *Int. J. Manag. Sustain.*, vol. 13, no. 2, pp. 448–464, 2024.

[15] N. Kemala and M. A. Pratama, "Cost dan Benefit Perkebunan Kelapa Sawit di PT IIS (Inti Indosawit Subur) Pada Awal Peremajaan di Desa Bulian Jaya Kecamatan Maro Sebo Ilir Kabupaten Batanghariâ€.," *J. MeA (Media Agribisnis)*, vol. 7, no. 1, pp. 43–48, 2022.

[16] N. Pinkerton, K. Schmidt, J. Xamplas, and R. Kolbe, "Estimation of production cost and revenue." The Northwestern University Chemical Process Design Open Textbook, 2017.

[17] M. S. Saepudin and D. S. Nugraha, "Biaya Produksi, Biaya Penjualan, Daya Beli dan Laba Bersih pada Perusahaan Manufaktur Periode 2020," *Indones. Account. Lit. J.*, vol. 2, no. 2, pp. 278–285, 2022.

[18] C. Suciana and N. Hayati, "Pengaruh Rasio Keuangan terhadap Pertumbuhan Laba (Studi Kasus Pada Perusahaan Subsektor Makanan dan Minuman yang Terdaftar di BEI Periode 2017-2019)," *J. Manaj. dan Akunt.*, vol. 22, no. 2, 2022.

[19] B. M. Balk, "Scale efficiency and productivity change," *J. Product. Anal.*, vol. 15, no. 3, pp. 159–183, 2001.

[20] C. Kao and S.-N. Hwang, "Scale efficiency measurement in two-stage production systems," in *Data Envelopment Analysis: A Handbook on the Modeling of Internal Structures and Networks*, Springer, 2014, pp. 119–135.

[21] K. M. Tan, F. Kamarudin, A. N. Bany-Ariffin, and N. A. Rahim, "Investigation on firm efficiency: evidence from selected Asia-Pacific countries," *Benchmarking An Int. J.*, vol. 25, no. 8, pp. 3062–3080, 2018.

[22] D. Gstach, "Scale Efficiency: Where Data Envelopment Analysis Outperforms Stochastic Production Function Estimation," 1993.

[23] F. R. Førsund and L. Hjalmarsson, "On the measurement of productive efficiency," *Swedish J. Econ.*, pp. 141–154, 1974.

[24] E. Nursanti, R. I. Purnama, and I. B. Suardika, "Optimasi Kapasitas Produksi untuk Mendapatkan Keuntungan Maksimum dengan Linear Programming," *Performa Media Ilm. Tek. Ind.*, vol. 14, no. 1, 2015.

[25] M. Ismail, N. S. N. Alimin, and A. Bathaei, "IMPROVING THE QUALITY AND PRODUCTIVITY OF PALM OIL THROUGH MECHANISATION IN PALM OIL COMPANIES," *Int. J. Ind. Manag.*, vol. 18, no. 4, pp. 212–222, 2024.

[26] R. D. Jack Hammesfahr, J. A. Pope, and A. Ardalan, "Strategic planning for production capacity," *Int. J. Oper. Prod. Manag.*, vol. 13, no. 5, pp. 41–53, 1993.

[27] S. Z. Y. Foong, V. Andiappan, D. C. Y. Foo, and D. K. S. Ng, "Flowsheet synthesis and optimisation of palm oil milling processes with maximum oil recovery," in *Green technologies for the oil palm industry*, Springer, 2018, pp. 3–32.

[28] A. Dumrongsiri, "Mathematical model for production, logistics and plant capacity planning of oil palm bunches," in *1st Mae Fah Luang University International Conference*, 2012.

[29] I. O. An-nisa, W. B. Utami, and I. L. Kusuma, "PENGARUH BIAYA PRODUKSI, BIAYA OPERASIONAL, DAN VOLUME PENJUALAN TERHADAP LABA BERSIH PERUSAHAAN SEKTOR INDUSTRI BARANG KONSUMEN PRIMER YANG TERDAFTAR DI BURSA EFEK INDONESIA (BEI) PERIODE 2020-2022," *J. Ilm. Manaj. dan Akunt.*, vol. 1, no. 4, pp. 179–188, 2024.

[30] S. Siswanto and C. F. Sari, "The Effect of Production and Sales Costs on Financial Performance: Study at One Agroindustry Company in Medan City," *J. Ekon. Bisnis Entrep.*, vol. 17, no. 1, pp. 103–111, 2023.

[31] O. Ojeda-Safra, B. Saravia-Goicochea, G. Viacava-Campos, and L. Cardenas-Rengifo, "A Model for Increasing Palm Oil Production Efficiency at an Agro-Industrial Company through Lean Manufacturing," in *Proceedings of the 7th International Conference on Industrial and Business Engineering*, 2021, pp. 339–344.

[32] S. P. Sari, "Analisis Pengaruh Kualitas Manajemen Operasional Terhadap Kinerja Perusahaan," *J. Ris. Manaj. DAN Ekon.*, vol. 3, no. 1, pp. 14–20, 2025.

[33] C. Kadurumba and S. I. Ume, "Determinant of Profit Efficiency among Small Scale Traditional Palm Oil Processors in Nigeria: A Profit Function Approach," *Int. J. Agric. Rural Dev.*, vol. 14, no. 2, pp. 716–721, 2011.

[34] M. K. Anam and S. Suhartini, "Efficiency of Palm Oil Companies in Indonesia: A DEA Approach," *Habitat*, vol. 31, no. 2, pp. 55–63, 2020.

[35] D. Miller, "The resource-based view of the firm," in *Oxford research encyclopedia of business and management*, 2019.

[36] P. M. Madhani, "Resource based view (RBV) of competitive advantage: an overview," *Resour. based view concepts Pract. Pankaj Madhani, ed*, pp. 3–22, 2010.

[37] M. Bertram, "Theoretical foundation: the resource-based view (RBV) of the firm," in *The strategic role of software customization: Managing customization-enabled software product development*, Springer, 2016, pp. 67–102.