

Maximum Profit Optimization of The Walang Marthafons Smoked Fish Business in Poka Village, Ambon

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ABSTRACT

Keywords:

Fish; linear; maximum; program; profit.

The main constraint faced by the Walang Marthafons smoked fish business in Poka Village is the inefficient use of production factors, resulting in suboptimal profits and a moderate value-added ratio. This study aims to analyze profit maximization using a linear programming approach. A case study method with a quantitative approach was applied. Data were collected through interviews and direct observations of the business owner. The analysis consisted of two stages: (1) profit analysis to determine actual profit based on total revenue and production costs, and (2) linear programming to identify the optimal production combination under constraints of raw materials, labor, and production capacity. The results indicate that the actual profit per production period is Rp 983.702, while the maximum attainable profit is Rp 1.490.430, representing an increase of 51,5%. The optimal production level is 38.8 kg per period, consisting of 22,5 kg of trevally, 5,8 kg of barramundi, and 10,5 kg of grouper. These findings suggest that production optimization can significantly improve business performance. Business owners are encouraged to adopt optimization techniques, while policymakers should support small-scale fisheries through training and improved access to resources, technology, and financing.

INTRODUCTION

One type of processed fish that is widely known among the people of Ambon City is smoked fish, locally referred to as *ikan asar*. This traditional product is processed through salting (brining) followed by hot smoking, resulting in a golden-brown product with a distinctive smoky flavor (Apituley et al., 2017). Since 2011, smoked fish processing businesses have been continuously encouraged by government agencies as part of the industrialization program initiated by the Ministry of Maritime Affairs and Fisheries (Luhur & Yusuf, 2017). This program aligns with the agro-industry concept, which focuses on transforming primary commodities into value-added products. In Ambon City, the development of micro and small enterprises (MSMEs) in fish processing is supported by the availability of raw materials, government-established processing groups, widespread business distribution, and high market demand (Siahainenia & Hiariey, 2017).

During the COVID-19 pandemic, smoked fish processing businesses in Ambon City remained relatively stable. One emerging business cluster is located along the coast of Ambon Bay, particularly outside Poka Village, Teluk Ambon District, where several business units operate, including Walang Marthafons, Lalosi, Mega Fish, and G & J Cafe. Previous research on the Walang Marthafons business unit indicated that it has a moderate value-added ratio (Talakua et al., 2022), suggesting the need for improved management practices. One important

approach is optimizing the use of production factors (inputs) to maximize business profits. Efficient allocation of inputs is essential to reduce production costs and enhance profitability.

However, empirical evidence shows that the use of production factors in fish processing industries, including smoked fish, is often not optimal. Studies in Semarang City revealed inefficiencies in both raw materials and supporting inputs such as furnaces, coconut shells, and labor (Setiwati, 2006). Other studies reported relatively high technical efficiency levels (96.17%) but did not necessarily reflect optimal profit conditions (Primalasari et al., 2019). Similarly, research on processed catfish production in Palembang found that production levels and profits were not maximized (Romadhon et al., 2021).

Despite these findings, previous studies tend to focus primarily on measuring efficiency or value-added without integrating optimization models that simultaneously consider resource constraints and profit maximization at the micro-business level. Furthermore, there is still limited research specifically addressing the optimization of production factors using quantitative approaches such as linear programming in small-scale smoked fish enterprises in Ambon City. This indicates a clear research gap in applying systematic optimization methods to improve decision-making in local fish processing MSMEs.

Optimization refers to achieving the best possible outcome under given conditions. According to Atika (2014), optimization can be achieved through maximization (allocating inputs to obtain maximum profit) or minimization (producing a certain output level with minimal inputs). One analytical tool capable of addressing such problems is linear programming. This method determines the optimal value of decision variables to maximize or minimize an objective function while considering constraints (Abdillah, 2013). Linear programming is particularly useful for allocating limited resources among competing activities efficiently (Aini et al., 2021).

Therefore, this study offers novelty by applying a linear programming approach to optimize the allocation of production factors in a small-scale smoked fish business, specifically Walang Marthafons in Poka Village. Unlike previous studies that focus only on efficiency measurement, this research integrates resource constraints and profit maximization into a single analytical framework, providing a more comprehensive and practical decision-making tool for MSMEs.

Based on this background, the main problem faced by the Walang Marthafons smoked fish business is the suboptimal use of production factors, resulting in unachieved maximum profit and only moderate value-added. Therefore, this study aims to analyze and determine the optimal production combination that maximizes profit using a linear programming approach.

METHOD

This study employed a case study method with a quantitative approach. The research was conducted at the Walang Marthafons smoked fish processing business in Poka Village, Teluk Ambon District, Ambon City, from June to August 2021. The research location was purposively selected based on the following considerations (Sugiyono, 2017):

1. The business generates value-added products, but the value-added ratio remains moderate.
2. The business operates continuously, producing and selling smoked fish on a daily basis.

Data Collection Methods

The data used in this study consisted of primary and secondary data. Primary data were obtained through direct observation and interviews with key informants, including the business owner and nine workers (including fish suppliers), using structured questionnaires.

The use of key informants is appropriate in a case study design, as this approach emphasizes in-depth information from individuals directly involved in the phenomenon under investigation (Rashid et al., 2019). Secondary data were obtained from relevant institutions, such as the Poka Village Government Office, as well as from literature and scientific publications.

Data Analysis Methods

To answer the research objectives, the following analysis was carried out:

1. Analysis of operating profit (actual) through equation (Shinta, 2011):

$$\pi = TR - TC$$

where π is profit (Rp/production), TR is total revenue (Rp/production), and TC is total cost (Rp/production), with total revenue (Rangkuti, 2012):

$$TR = P \times Q$$

where TR is total revenue (Rp/production), P is selling price (Rp/head or Rp/kg), and Q is quantity or total production (kg/production). Total cost with equation (Shinta, 2011):

$$TC = FC + VC$$

where TC is total cost (Rp/production), FC is fixed cost (Rp/production), VC is variable cost (Rp/production). The calculation of depreciation (at fixed costs) using the straight-line method is: depreciation expense (Rp/year) = (acquisition cost (Rp) - residual value (Rp))/useful life (Year) (Mairuhu & Tinangon, 2014).

2. Analysis of business profit maximization with linear programming. The general mathematical equation for linear programming is (Shinta, 2011):

$$Z = \sum_{j=1}^n C_j X_j;$$

$$\sum_{j=1}^n a_{ij} X_j \leq b_i;$$

$$\text{and } X_j \geq 0$$

where C_j is coefficient of decision-making variables in the objective function, X_j is total output of the j -th optimum production sought, a_{ij} is the coefficient of the j th production input variable in the i -th constraint function, b_i is production factor owned for the i -th constraint function, n is number of decision variables, and Z is the scalar value of the objective function. The general equation is modified, so that the application of the general equation is:

- a. Purpose function:

$$\text{Maximum } Z = C_1 X_1 + C_2 X_2 + C_3 X_3$$

where: Z is the maximum profit obtained by the Walang Marthafons Smoked Fish Business, C_1 is revenue per amount of asar trevally production, X_1 is total production of smoked fish (trevally), C_2 is revenue per total barramundiproduction, X_2 is total production of smoked fish (barramundi), C_3 is revenue per total grouper production, and X_3 is total production of smoked fish (grouper).

- b. Constraint function:

$$K_1: a_{1j} X_1 + a_{1j} X_2 + a_{1j} X_3 \leq b_1$$

$$K_2: a_{2j} X_1 + a_{2j} X_2 + a_{2j} X_3 \leq b_2$$

$$K_3: a_{3j} X_1 + a_{3j} X_2 + a_{3j} X_3 \leq b_3$$

$$K_4: a_{4j} X_1 + a_{4j} X_2 + a_{4j} X_3 \leq b_4$$

$$K_5: a_{5j} X_1 + a_{5j} X_2 + a_{5j} X_3 \leq b_5$$

$$K_6: a_{6j} X_1 + a_{6j} X_2 + a_{6j} X_3 \leq b_6$$

$$K_7: a_{7j} X_1 + a_{7j} X_2 + a_{7j} X_3 \leq b_7$$

$$K_8: a_{8j} X_1 + a_{8j} X_2 + a_{8j} X_3 \leq b_8$$

$$K_9: a_{9j} X_1 + a_{9j} X_2 + a_{9j} X_3 \leq b_9$$

$$K_{10}: a_{10j} X_1 + a_{10j} X_2 + a_{10j} X_3 \leq b_{10}$$

$$K_{11}: a_{11j} X_1 + a_{11j} X_2 + a_{11j} X_3 \leq b_{11}$$

$$K_{12}: a_{12j} X_1 + a_{12j} X_2 + a_{12j} X_3 \leq b_{12}$$

$$K_{13}: a_{13j} X_1 + a_{13j} X_2 + a_{13j} X_3 \leq b_{13}$$

$$K_{14}: a_{14j} X_1 + a_{14j} X_2 + a_{14j} X_3 \leq b_{14}$$

$$K_{15}: a_{15j} X_1 + a_{15j} X_2 + a_{15j} X_3 \leq b_{15}$$

$$K_{16}: a_{16j} X_1 + a_{16j} X_2 + a_{16j} X_3 \leq b_{16}$$

$$K_{17}: a_{17j} X_1 + a_{17j} X_2 + a_{17j} X_3 \leq b_{17}$$

$$K_{18}: a_{18j} X_1 + a_{18j} X_2 + a_{18j} X_3 \leq b_{18}$$

$$K_{19}: a_{19j} X_1 + a_{19j} X_2 + a_{19j} X_3 \leq b_{19}$$

$$K_{20}: a_{20j} X_1 + a_{20j} X_2 + a_{20j} X_3 \leq b_{20}$$

$$K_{21}: a_{21j}X_1 + a_{21j}X_2 + a_{21j}X_3 \leq b_{21}$$

$$K_{22}: a_{22j}X_1 + a_{22j}X_2 + a_{22j}X_3 \leq b_{22}$$

$$K_{23}: a_{23j}X_1 + a_{23j}X_2 + a_{23j}X_3 \leq b_{23}$$

$$K_{24}: a_{24j}X_1 + a_{24j}X_2 + a_{24j}X_3 \leq b_{24}$$

where K1 to K24 is constraints for main raw materials, constraints on complementary raw materials, constraints on product packaging/packaging, and constraints on fixed costs; a_{1j} to a_{24j} is coefficient of production inputs in the function of the main raw material constraint, the complementary raw material constraint, the product packaging constraint, and the fixed cost constraint. Each coefficient value for each constraint is obtained from the equation: (amount of each production factor/amount of smoked fish production) x percentage of total production of each species; X1 is trevally; X2 is barramundi; X3 is grouper, and b_1 to b_{24} is production factors owned/ available for each constraint function.

Linear program analysis was carried out using POM-QM software for windows (Weiss 2013).

RESULT AND DISCUSSION

Business Profit

Business profit refers to the actual profit earned by the Walang Marthafons smoked fish business in each production period during June–August 2021. One production period span two days, covering the entire process from raw material preparation to product sales.

The results indicate that the business generates a profit of IDR 983,702 per production period (Table 1). This value is derived from total revenue of IDR 6,300,000 and total production costs of IDR 5,316,298. This finding suggests that although the business is profitable, there is still significant potential for profit improvement through better resource allocation.

Table 1. Actual Business Profit

Description	Total Revenue (Rp/production)	Total Cost (Rp/production)	Profit (Rp/production)
Value	6.300.000	5.316.298	983.702

Source: Primary data, 2021.

Business revenue of Rp 6.300.000 was obtained from the production and sale of smoked fish species of trevally/kuwe (*Caranx* sp.), barramundi (*Lates calcarifer*), and grouper (*Epinephelus* sp.). The number of smoked fish products sold in each production period is 16,5 kg of trevally (consisting of: 9 kg of small trevally and 7,5 kg of large trevally), 5,1 kg of barramundi (consisting of: 1,8 kg and 3,3 kg small barramundi), and 3,5 kg grouper, or calculated in kilograms is 25,1 kg per production period. The price of smoked fish products ranges from Rp 85.000 to Rp 300.000 per product (depending on size). The price range is described per size and species, Rp 85.000 per small trevally and Rp 175.000 per large barramundi, Rp 80.000 per small barramundi and Rp 300.000 per large barramundi, and Rp 150.000 per small grouper and Rp 300.000 per large grouper. If it is calculated based on the price per kilogram, price of the products ranges from Rp 206.897 to Rp 283.333 per kilogram.

Smoked fish production process costs money. The costs incurred are variable costs and fixed costs. The variable costs for each production period consist of the main raw material costs of Rp 4.350.000, complementary raw materials costs of Rp 609.000, and the packaging costs of Rp 73.000, total variable costs of Rp 5.032.000. Fixed costs consist of electricity and water costs are Rp 600.000 per month, labor costs are Rp 2.500.000 per month, and depreciation costs are Rp 564.472 per month, total fixed costs per month is Rp 4.264.472, or if calculated to each production period is Rp 284.298.

Objective Function and Constraints

The actual business profit analysis data is depicted in Table 1, formulated as objective functions and constraints to be used in linear programming analysis. Table 2 shows that, there are three (3) variables in the objective function that represent three types of salted fish products, namely: trevally/kuwe (symbol X1), barramundi (symbol X2), and grouper (symbol X3). Each of these three variables has a coefficient value obtained from a comparison of the receipts and the amount of production of each type of smoked fish. Each of these coefficient values is IDR 40,219/kg of trevally, IDR 40,195/kg of barramundi, and IDR 33,459/kg of grouper. In Table 2 there are also twenty-four (24) constraints consisting of five (5) main raw material constraints, sixteen (16) complementary raw material constraints, two (2) packaging materials, and one (1) fixed cost. Each of these constraints has an input coefficient value (factor of production) for each objective function variable and the total availability of production factors as the right-hand side (RHS) value. Specifically, for the availability of the main raw materials, the results of the interviews show that the amount available is three (3) times the amount of inventory for each production, this is because fresh fish stock as the main raw material comes from the production of fish farming by the owner of the Walang Marthafons Smoked Fish Business in Poka Village. All values in the objective and constraint functions describe the actual profits and production factors obtained and used in Walang Marthafons Smoked Fish Business in Poka Village per production period.

Table 2. Objective Function and Constraints

No.	Description	Symbol / Coefficient Value			Availability	Unit
1.	Objektive function:					
	a. Variable	trevally (X1)	barramundi (X2)	grouper (X3)		
	b. Business revenue per production:	40,219	40,195	33,459		Rp
2.	Function constraints:					
	a. Main raw material:					
	1) Small trevally	1,333	0.000	0.000		36 kg
	2) Large trevally	1,067	0.000	0.000		24 kg
	3) Small barramundi	0.000	0.857	0.000		5 kg
	4) Large barramundi	0.000	1,091	0.000		11 kg
	5) Small grouper	0.000	0.000	1.143		12 kg
	b. Complementary raw materials:					
	1) Tomatoes	0.105	0.032	0.022		4 kg
	2) Little chili	0.026	0.008	0.006		1 kg
	3) Red onion	0.026	0.008	0.006		1 kg
	4) Lime	0.026	0.008	0.006		1 kg
	5) Salt	0.026	0.008	0.006		1 Pack
	6) Sugar	0.026	0.008	0.006		1 Kg
	7) Cucumber	0.131	0.040	0.028		5 Piece
	8) Cabbage	0.053	0.016	0.011		2 Piece
	9) Long beans	0.105	0.032	0.022		4 Bunch
	10) Eggplant	0.263	0.080	0.056		10 Piece
	11) Basil	0.105	0.032	0.022		4 Bunch
	12) Coconut shell/Charcoal	0.026	0.008	0.006		1 Sack
	13) Kerosene	0.131	0.040	0.028		5 Liter
	14) Coconut oil	0.026	0.008	0.006		1 Liter
	15) Sweet soy sauce	0.026	0.008	0.006		1 Bottle
	16) Rice	0.263	0.080	0.056		10 Kg

No.	Description	Symbol / Coefficient Value			Availability	Unit
c. Packer:						
1)	Plastic bag	0.026	0.008	0.006		1 Pack
2)	Mica food wrapper	0.526	0.161	0.112		20 Piece
d.	Fixed cost	7,476	2,288	1,586	284,298	Rp

Source: Primary data, 2021.

Maximum Profit

The maximum profit of Walang Marthafons Smoked Fish Business is Rp 1.490.430 per production period. Maximum profit is achieved if the amount of production is at optimal conditions. Table 3 shows the optimal combination of smoked fish production: 22,5 kg of trevally, 5,8 kg of barramundi, and 10,5 kg of grouper. The amount of production is optimal because the reduced cost value for all species of smoked fish is equal to zero (reduced cost = 0). Activities included in the optimal program will have a reduced cost or opportunity cost equal to zero (Aini et al., 2021). In Table 3 there are also other primal analysis results, the original value which is the selling price of smoked fish products per species and the lower bound and upper bound on the amount of production at the optimal level which shows that the business cannot produce (lower limit equals zero) and can produce up to an infinite number of products (upper limit equal to infinity). This condition is possible because the main raw materials in the form of trevally/barramundi/and fresh grouper are the results of aquaculture activities with floating net cages which are also owned by the owner of the business or there is no dependence on the main raw materials from other businesses (other producers) or from nature. Primal analysis will explain the concept of the optimal product combination in generating the maximum profit contribution for the business unit (Septiadi & Nursan, 2020).

Table 3. Comparison of Actual and Optimal Production

No.	Variable	Actual	Optimal Production				
		Production (kg)	Production (kg)	Reduced cost	Initial Value	Lower Limit	Upper Limit
1.	Trevally (X_1)	16,5	22,5	0	40.219	0	∞
2.	Barramundi (X_2)	5,1	5,8	0	40.195	0	∞
3.	Grouper (X_3)	3,5	10,5	0	33.459	0	∞

Source: Primary data, 2021.

The comparison or difference between the maximum and actual profits in the smoked fish business is shown in Table 4. The maximum profit obtained is more than the actual profit, the difference reaches Rp 506.728 per production period. This means that the actual profit is can/needs to be increased up to 51,5%. Increase in business profits, apart from referring to the optimal level of production, can also be done through the minimization (efficiency) of the cost of production factors. The primal analysis aims to maximize revenue, while the dual analysis aims to minimize costs (Aini et al., 2021). Table 5 shows results of the dual analysis in a linear program.

Table 4. Actual and Maximum Profit

Description	Profit (Rp/production)		Difference Between Actual and Maximum Profit (Rp/production)
	Actual	Maximum	
Value	983.702	1.490.430	506.728

Source: Primary data, 2021.

Value of slack/surplus (excess) of twenty-four (24) production factors/resources in the business shows that there are three (3) production factors whose use has been maximized (used up/limited), that is large trevally, small barramundi, and small grouper, where the slack/surplus value is equal to zero. Twenty-one (21) other production factors have not been

maximized (available in excess) because the slack/surplus values are not equal to or more than zero. The slack/surplus value describes the amount of excess or lack of resource utilization at the optimal activity level. If the slack/surplus value is zero, it means that the resource is used up (rare), on the other hand, if the slack/surplus value is not equal to zero, it means that the resource is available in excess (Kurniati & Darus, 2018).

Value of dual price for twenty-four (24) production factors/resources shows that each addition of each kilogram of production factors for large trevally, small barramundi, and small grouper will increase the value of the objective function (increase the maximum profit) for each of its dual price values. For example: the addition of 1 kg of large trevally production will increase business profits by Rp 37.693,53 per production period. Value of dual price on limited resources shows that each additional resource by one unit will increase the value of the objective function by the value of its dual price (Septiadi & Nursan, 2020). Addition or subtraction of twenty-one (21) other factors of production will not increase or decrease the value of the objective function (increase/decrease maximum profit) because the dual price value of twenty-one (21) other factors of production is equal to zero. The value equal to zero indicates that the resource is in an inactive or excess constraint status, where the addition or reduction of availability of these resources will not affect the value of the objective function.

Table 5. Use of Production Factors in Optimal Conditions

No.	Constraint	Availability	Use		Slack/ Surplus	Dual price
			Lower Limit	Upper Limit		
1.	Small trevally	36	29,9831	∞	6,0169	0
2.	Large trevally	24	0	28,8162	0	37.693,53
3.	Small barramundi	5	0	8,6407	0	46.901,98
4.	Large barramundi	11	6,3652	∞	4,6348	0
5.	Small grouper	12	0	70,2008	0	29.272,96
6.	Tomatoes	4	2,7794	∞	1,2206	0
7.	Little chili	1	0,6945	∞	0,3055	0
8.	Red onion	1	0,6945	∞	0,3055	0
9.	Lime	1	0,6945	∞	0,3055	0
10.	Salt	1	0,6945	∞	0,3055	0
11.	Sugar	1	0,6945	∞	0,3055	0
12.	Cucumber	5	3,4739	∞	1,5261	0
13.	Cabbage	2	1,401	∞	0,599	0
14.	Long beans	4	2,7794	∞	1,2206	0
15.	Eggplant	10	0,6945	∞	0,3055	0
16.	Basil	4	3,4739	∞		0
17.	Coconut shell/Charcoal	1	0,6945	∞	0,3055	0
18.	Kerosene	5	3,4739	∞	1,5261	0
19.	Coconut oil	1	0,6945	∞	0,3055	0
20.	Sweet soy sauce	1	0,6945	∞	0,3055	0
21.	Rice	10	6,9703	∞	3,0297	0
22.	Plastic bag	1	0,6945	∞	0,3055	0
23.	Mica food wrapper	20	13,9465	∞	6,0535	0
24.	Fixed cost	284.298	198.157,3	∞	86.140,73	0

Source: Primary data, 2021.

Important production factors/resources that need to be managed properly are raw materials for large trevally, small barramundi, and small grouper. Value of the lower limit and upper limit in Table 5 shows that the raw material for large trevally cannot be used in the production process (lower limit is equal to zero) and in the production process it can only be

used up to 28,8 kg (upper limit = 28,8162). Barramundi raw materials cannot be used in the production process (lower limit equal to zero) and in the production process can only be used up to 8.6 kg (upper limit = 8,6407). Small grouper raw materials cannot be used in the production process (lower limit equal to zero) and in the production process can only be used up to 70,2 kg (upper limit = 70,2008). The management of twenty-one (21) other production factors is based on the use value of the lower limit, for example: raw materials for small trevally should not be less than 29,9 kg (lower limit = 29,9831) and can be used up to infinity (upper limit = ∞). However, this unlimited use will not increase the maximum profit, instead it will cause business inefficient (waste). Production factors that have a slack/surplus value greater than zero indicate that these production factors have been excessive so it needs to be reduced so that there is no decrease in the amount of production and cost wastage (Kurniati & Darus, 2018).

The results reveal that the actual profit of IDR 983,702 per production period can be increased to IDR 1,490,430 under optimal conditions, indicating a potential improvement of 51.5%. This substantial gap suggests that the business is not yet operating at allocative efficiency, where production inputs are optimally distributed to maximize profit. From an economic perspective, this finding reflects the presence of both technical and economic inefficiencies, particularly in determining the optimal combination of outputs. In practice, small-scale agro-processing enterprises often rely on habitual production patterns rather than analytical decision-making, which leads to suboptimal resource allocation. This condition implies that the firm operates below its production frontier, as predicted in microeconomic production theory.

The optimization results further demonstrate a significant shift in the production composition. The optimal solution recommends increasing the production of trevally and especially grouper, while only slightly adjusting barramundi output. This shift indicates that these products provide higher marginal profit contributions, and thus should receive priority in resource allocation. The substantial increase in grouper production, despite its initially low actual output, highlights an underutilized opportunity for value addition. This finding confirms the principle of profit maximization under resource constraints, where rational producers allocate resources toward products with the highest marginal returns.

The dual analysis provides deeper insights into resource utilization. Among the 24 production factors, only three—large trevally, small barramundi, and small grouper—act as binding constraints, as indicated by zero slack values and positive dual prices. These inputs represent scarce resources that directly determine the maximum achievable profit. The dual price (shadow price) associated with each constraint reflects the marginal value of an additional unit of the resource. For example, the shadow price of large trevally indicates that increasing its availability by one kilogram would significantly increase profit. Therefore, these resources should be prioritized in production planning and management. In contrast, the majority of production factors exhibit positive slack values and zero dual prices, indicating that they are used in excess. Economically, this condition reflects cost inefficiency, as additional usage of these inputs does not contribute to increased output or profit. The presence of redundant inputs suggests that the business has not yet achieved cost minimization, and there is an opportunity to reduce production costs without negatively affecting output levels. Efficient resource management should therefore focus not only on increasing scarce inputs but also on reducing the use of non-critical inputs.

The findings of this study are consistent with Kumar et al. (2016), who reported that small-scale aquaculture enterprises often operate below optimal efficiency due to improper input allocation and managerial limitations. However, a notable distinction in this study is that the primary raw materials are internally supplied, reducing dependency on external markets and providing a structural advantage that is not always present in other contexts. The observed improvement in profit under optimal conditions also aligns with Adewumi et al. (2017), who demonstrated that the application of linear programming can significantly enhance profitability through improved resource allocation. While their study emphasized raw material scarcity as

the primary constraint, the present study reveals that inefficiency may also arise from suboptimal allocation of available resources, even when supply is relatively sufficient. Furthermore, the role of shadow pricing in identifying critical resources supports the findings of Rahman et al. (2018), who highlighted the importance of prioritizing inputs with positive shadow prices in resource allocation decisions. Unlike previous studies that focus on general constraints such as land or capital, this study identifies specific raw material types as the key limiting factors, providing a more detailed understanding of resource constraints in small-scale fish processing. The existence of excess inputs in this study is also consistent with Cheng et al. (2019), who found that small-scale food processing enterprises often experience input redundancy, leading to higher production costs without increasing output. However, while Cheng et al. emphasized technological limitations as the main source of inefficiency, this study suggests that managerial decision-making plays a more critical role in determining input use efficiency. Finally, the adjustment in the optimal production mix supports the findings of Olagunju et al. (2020), who demonstrated that profit maximization in fisheries can be achieved by reallocating resources toward products with higher marginal returns. This study extends their findings by showing that even in conditions where raw material availability is not a major constraint, inefficient production combinations can still significantly reduce profitability.

CONCLUSION

The maximum profit of the Walang Marthafons smoked fish business in Poka Village is IDR 1.490.430 per production period, which is 51,5% higher than the actual profit. This maximum profit can be achieved when total production reaches 38,8 kg per period, consisting of 22,5 kg of trevally, 5,8 kg of barramundi, and 10,5 kg of grouper. Therefore, the business owner is recommended to adjust the production composition toward this optimal level in order to maximize profit.

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