Analysis of Value-Added and Calculation of Production Cost in the Production of Processed Coconut Product

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Abstract— **Coconut is a potential commodity to be developed. The development of coconut agro-industry can increase product added value. Value-added analysis needs to be carried out to find out how much the added value of processed coconut product is. The calculation of basic costs also needs to be done to find out how much it costs to produce 1 unit or 1 kg of product. This research is beneficial as decision support through useful information for coconut farmers in increasing their income. Value-added analysis in this study used the Hayami method, while the calculation of the cost of processing involves fixed costs, variable costs, working hours, and production capacity. The study was conducted in Indragiri Hilir Regency, Riau. Product selection is based on previous research, which shows that prospective products developed are coconut oil, coconut sugar, and shell charcoal. Data collection was carried out in three districts, namely Mandah, Reteh, and Enok. The results showed that each product's added value was IDR 1,037.79 per kg in coconut sugar processing, IDR 760 per kg in coconut oil processing, and IDR. 249.98 per kg in shell charcoal processing. The results of the calculation of the cost of processing, the results obtained the production cost of charcoal processing is IDR 472.92 per kg, for coconut oil processing is IDR 14,939.13 per kg, and for processing of coconut sugar, it is IDR 8,535.07 per kg. The three products' production cost is far less than the selling price, so the business is quite profitable.**

Keywords—**Coconut agro-industry; cost of production; Hayami method; value-added analysis.**

I. INTRODUCTION

Coconut-based agro-industry is a promising sector to be developed. Especially if it is developed in an integrated way, this can provide an added value and increase smallholder plantation efficiency [1]. Integrated coconut agro-industry is defined as agro-industry that processes coconuts from various raw material sources, from coconut sap, water, coconut meat, and by-products such as sticks, shells, and coir. One of the coconut centers in Indonesia is Indragiri Hilir Regency. Previous research shows that prospective areas for developing coconut agro-industry in Indragiri Hilir are Mandah, Reteh, and Enok sub-districts [2]. The selection is based on the criteria of population, plantation area, production, and a number of coconut farmers.

The prospective processed products developed in Indragiri Hilir are coconut oil, coconut sugar, and charcoal from coconut shells. The product selection is based on several criteria: the availability of raw materials, employment,

technology used, product added value, environmental impact, market opportunities, product quality, product distribution, and government policy [3]. To develop a coconut-based agro-industry well, it is necessary to know the added value of each processed product. The value-added analysis is an analysis needed to determine the added value of a food product after processing. Factors that influence added value analysis are capital, labor, human resources, and management factors [4].

Several studies on the added value of processed agricultural products have been carried out, such as chocolate, mango dodol, fruit syrup, and sago [4]–[7], while the analysis of the added value of coconut-based products that have been carried out include analysis of added value on copra, brown sugar, nata de coco, and VCO [4], [8] –[10]. Some of these studies show the importance of an analysis of added value to a processed product, namely, to find out how much value-added from a raw material undergoing processing.

The added value of a product illustrates the increase in products that producers to consumers can offer. This can be

considered a special feature added by coconut craftsmen to increase the value of coconut products. Adding value to coconut products is especially important because it provides incentives for consumers to make purchases, thereby increasing the income of coconut craftsmen. The added value obtained from processing a coconut product can be used Hayami method. The advantage of adding value analysis using the Hayami method is knowing value-added, output value, and productivity. Besides, it can also find out the amount for remuneration for owners of factors of productions. Based on the added value principle, Hayami can be applied to other subsystems outside of processing, such as for marketing activities [11]. In addition to product value-added, the calculation of processing costs also needs to be done. This is necessary to provide information to coconut craftsmen about the number of costs that must be incurred during processing. The basic processing cost depends on the number of fixed costs, variable costs, and the processing equipment/machinery's capacity during the processing [12].

Fixed cost does not change with an increase or decrease in the number of goods produced. Fixed costs are costs that must be paid by coconut craftsmen, regardless of certain business activities. In general, coconut craftsmen's fixed costs must pay for processing coconut are the cost of capital interest and depreciation costs. Capital interest costs are costs of funds used to finance the construction of long-term assets that coconut craftsmen build. Depreciation costs are left over from an asset after the corresponding accumulated depreciation amount has been deducted from it.

Variable costs are costs that change proportionally to production output. Variable costs increase or decrease depending on the company's production volume. Variable costs increase with increasing production and decrease with decreasing coconut production. Variable costs in coconut processing include raw material costs, labor costs, and additional material costs. Most coconut farmers in Indragiri Hilir Regency are more likely to sell fresh coconut compared to processing it into other products. This is due to the lack of information about the product's added value and information about the basic cost of producing each processed product. Therefore, in this study, an analysis of value-added and calculating the cost of processing the coconut oil, coconut sugar, and shell charcoal products in Indragiri Hilir district. This research is beneficial as decision support through useful information for coconut farmers in increasing their income.

II. MATERIALS AND METHODS

The study was conducted in Indragiri Hilir Regency, Riau. Data collection was carried out in three districts, namely Mandah, Reteh, and Enok. This sub-district selection is based on previous research, which shows that prospective sub-districts for the development of coconut agro-industry in Indragiri Hilir are the three sub-districts. Product selection is also based on previous research, which shows that prospective products developed are coconut oil, coconut sugar, and shell charcoal [3].

Data processing for value-added analysis using the Hayami method. The Hayami method is a method for calculating the added value, which Hayami developed in 1987 by combining processing added value and marketing added value [10], [13]–

[15]. The template for the Hayami method can be seen in Table 1.

TABLE I
TEMPLATES FOR THE HAYAMI METHOD

No	Variable	Notation
	Output and Input	
1	Production (kg/day)	A
2	Raw material (kg/day)	B
3	Labor (NWH/day)	C
4	Conversion factor	D = A/B
5	Coefficient of labor	E = C/B
6	Average product price (IDR/kg)	F
7	Average wage (IDR/NWH)	G
	Income and Profit	
8	Cost of Raw material (IDR/kg)	H
9	Contribution of additional input (IDR/kg)	I
10	The value of product (IDR/kg)	J = D*F
11	a. Value-Added (IDR/kg)	K = J-H-I
	b. Ratio of Value-Added	L = K/J*100%
12	a. Labor salary (IDR/kg)	M = E*G
	b. Labor share	N = M/K*100%
13	a. Profit (IDR/kg)	O = K-M
	b. Profit level	P = O/K*100%
	Share of the Owner of Production Factor	
14	Margin (IDR/kg)	Q = J-H
	a. Owner's income	R = M/Q*100%
	b. Contribution of Additional Input	S = I/Q*100%
	c. Profit of Owner	T= O/Q*100%

Calculation of the cost of processing using the formula as follows [12]:

$$BP = \frac{\frac{BT}{n}+BTT}{KP} \qquad (1)$$

Where:
BP   = Basic Cost of Processing (IDR/kg)
BT   = Fixed Cost of Processing (IDR/year)
BTT   = Variable Cost of Processing (IDR/hour)
n   = Number of Work Hour per year
KP   = Processing Capacity (kg/hour)

Basic cost (production cost) is the cost needed to produce one unit of output. In the production of processed coconut commodities, the primary cost is producing one kg of the processed coconut commodity. In general, basic costs are defined as costs incurred per unit of product. Fixed costs are costing whose total amount remains constant, not influenced by changes in the volume of activities or activities to a certain degree. Fixed costs per unit are inversely proportional to changes in activity volume or capacity. The higher the level of activity, the lower the fixed costs per unit. The lower the level of activity, the higher the fixed costs per unit. Concerning cost behavior, fixed costs can be classified into two, namely, committed fixed costs and discretionary fixed costs [16]. Variable costs are costing whose total amount changes proportionally with the change in activity volume. The higher the volume of activities or activities, the proportionally the higher the total variable costs. The lower the volume of activities, the proportionally lower the total variable costs.

III. Results and Discussion

Value-added analysis and calculation of processing costs are calculated based on fixed cost data, variable costs, work capacity, labor costs, and other data. The data needed for the analysis can be seen in Table 2. It can be seen that the average fixed cost for coconut oil processing is IDR 881,355 per year, while the variable costs range from IDR 4,568.75 per hour to IDR 10,512.5 per hour (Table 2). The average fixed cost for coconut sugar processing is IDR 1,082,355 per year, while the average variable cost is IDR 9,858.38 per hour. The fixed cost for charcoal processing ranges from IDR 699,750 per year to IDR 1,119,600 per year, while the average variable cost is IDR 13,500 per hour.

TABLE II
DATA PROCESSING OF COCONUT COMMODITIES IN EACH DISTRICT

Description	Mandah	Reteh	Enok
Coconut Oil			
Fixed Cost (IDR/year)	881,353	881,353	881,353
Variable Cost (IDR/hour)	4,568.75	10,512.5	5,900
Raw Material (kg)	42.5	144.5	34
Production (kg)	3.5	12	3
Raw Material Price (IDR/kg)	529.41	529.41	529.41
Product Selling Price (IDR/kg)	17,000	17,000	17,000
Number of Work Hour (hour/year)	384	1,344	264
Processing Capacity (kg/hour)	0.438	0.857	0.375
Coconut Sugar			
Fixed Cost (IDR/year)	1,082,355	1,082,355	1,082,355
Variable Cost (IDR/hour)	9,859.38	9,859.38	9,859.38
Raw Material (kg)	100	75	100
Production (kg)	10	9	10
Raw Material Price (IDR/kg)	500	500	500
Product Selling Price (IDR/kg)	16,000	16.000	16,000
Number of Work Hour (hour/year)	2,400	1,920	2,880
Processing Capacity (kg/hour)	1.250	1.125	1.250
Charcoal			
Fixed Cost (IDR/year)	839,700	699,750	1,119,600
Variable Cost (IDR/hour)	13,500	13,500	13,500
Raw Material (kg)	600	500	800
Production (kg)	150	125	200
Raw Material Price (IDR/kg)	1,000	1,000	1,000
Product Selling Price (IDR/kg)	5,000	5,000	5,000
Number of Work Hour (hour/year)	600	600	600
Processing Capacity (kg/hour)	30	25	40

The amount of production of coconut oil, coconut sugar, and charcoal in each district is different. This is caused by the different amounts of raw materials used. The average production of coconut oil is 6.17 kg, while the average production of coconut sugar is 9.33 kg, and the average production of charcoal is 158.33 kg. Processing capacity in coconut oil processing range from 0.375 to 0.857 kg per hour, with an average of 1.67 kg per hour. The average processing capacity for coconut sugar is 1.25 kg per hour, while the average processing capacity for charcoal is 31.67 kg per hour. Processing capacity can be interpreted as the maximum amount of output that can be produced in a certain period of time. Factors that can affect production capacity include the number of labors, the ability and expertise of labor, the number of machines and work equipment used, machine maintenance, supply of raw materials, and work productivity.

A. Value-Added Analysis

The data in Table 2 is used for value-added analysis and calculates the cost of processing. Analysis of value-added on processed coconut commodities can be seen in Table 3. According to Hayami, added value is the added value of a commodity because of the processing, transport, or store in production. The analytical method used to determine the added value of coconut processing is the Hayami method [17]. The value-added calculation is carried out in processing coconut in the study area to measure the added value that occurs due to processing coconut into coconut oil, coconut sugar, and charcoal.

TABLE III
DATA PROCESSING OF COCONUT COMMODITIES IN EACH DISTRICT

No	Variable	Notation		
		Coconut Oil	Coconut Sugar	Charcoal
	Output and Input			
1	Production (kg/day)	6.17	9.67	158.33
2	Raw material (kg/day)	73.67	91.67	633.33
3	Labor (NWH/day)	1	1	1
4	Conversion factor	0.0838	0.1055	0.2499
5	Coefficient of labor	0.0136	0.0109	0.0016
6	Average product price (IDR/kg)	17,000	16,000	5,000
7	Average wage (IDR/NWH)	47,700	63,875	67,500
	Income and Profit			
8	Cost of Raw material (IDR/kg)	529.41	500	1,000
9	Contribution of additional input (IDR/kg)	134.37	150	0
10	The value of product (IDR/kg)	1,423.78	1,687.79	1,249.98
11	a. Value-Added (IDR/kg)	760	1,037.79	249.98
	b. Ratio of Value-Added	53%	61%	20%
12	a. Labor salary (IDR/kg)	647.48	696.79	106.58
	b. Labor share	85%	67%	43%
13	a. Profit (IDR/kg)	112.52	341.00	143.40
	b. Profit level	15%	33%	57%
	Share of the Owner of Production Factor			
14	Margin (IDR/kg)	894.37	1,187.79	249.98
	a. Labor's income	72%	59%	43%
	b. Contribution of Additional Input	15%	13%	0%
	c. Profit of Owner	13%	29%	57%

1) Output and Input

Table 3 shows that 6.17 kg of coconut oil per day was obtained from 73,67 kg of raw material, 9.67 kg of coconut sugar was obtained from 91,67 158,33 kg of charcoal from 633,33 kg of raw material. The calculation results for the conversion factor from coconut-to-coconut oil equal to 0.0838, which means everyone kilogram of coconut produces 0.0838 kg of coconut oil. The coconut conversion factor to coconut sugar is equal to 0.1055, which means everyone kilogram of coconut produces 0.1055 kg of coconut sugar. The conversion factor from coconut to charcoal is equal to 0.2499, which means everyone kilogram of coconut produces 0.2499 kg of charcoal. The conversion factor is obtained by dividing the output amount by the number of inputs (production/raw material).

The coefficient of labor is a division between labor with raw materials used in the production process. The calculation results show that the coefficients in the processing of coconut oil are 0.0136, in the processing of coconut sugar is 0.0109, and in processing, charcoal is 0,0016. This means that to produce 10,000 kg coconut into coconut oil required 136 labor, to produce 10,000 kg coconut into coconut sugar requires 109 labor, and to produce 10,000 kg of coconut into charcoal required 16 labor. The labor needs for coconut processing into coconut oil and coconut sugar more than charcoal treatment because of its processing through the stage, and the processing process still use manual technology with human power.

2) Income and Profit

Table 3 shows that the cost of coconut raw material for processing coconut oil is IDR 529.41 per kg. Meanwhile, the contribution of additional input to coconut oil processing is IDR 134.37 per kg, meaning each processing per kilogram of coconut is needed additional input contribution costs of IDR 134.37 obtained from the distribution between the total contributions of other inputs with the amount of raw material used. The contribution of additional input referred to is the amount of supporting material and equipment used. The cost of raw material for processing coconut sugar is IDR 500 per kg. Meanwhile, the contribution of additional input to coconut oil processing is IDR 150 per kg, meaning each processing per kilogram of sap is needed additional input contribution costs of IDR 150 obtained from the distribution between the total contributions of other inputs with the amount of raw material used. The cost of raw material for processing charcoal is IDR 1,000 per kg. Meanwhile, there are no costs from the contribution of additional inputs because, in charcoal processing, no additional input is needed.

It can be seen that the added value for coconut oil is IDR 760 per kg (Table 3), with a value-added ratio of 53%. This result is greater than the value added of coconut oil in other regions, such as the districts of July, Biruen (value-added 550 per kg), and Purworejo Regency (value-added 173 per kg) [13], [14]. In terms of profit, it can be seen that the profit in coconut oil processing is IDR 112,52 per kg, which means around 15%. The added value of coconut sugar processing in this study was IDR 1,037.79 per kg, with a value-added ratio of 61%. This is also greater than other regions, namely IDR 705.9 per liter of coconut sugar in Blitar [10]. In terms of profit, it can be seen that the profit in processing coconut sugar is IDR. 341 per kg, which means about 33%. Meanwhile, coconut shell charcoal processing's added value

is IDR 249.98 per kg, with a value-added ratio of 20%. This result is smaller than the added value of shell charcoal in July sub-district, Biruen Regency, which is IDR 560 per kg [13]. In terms of profit, it appears that the profit on processing shell charcoal is around IDR 143.4 per kg, which means about 57% of the profit.

The value-added ratio in coconut oil and coconut sugar processing is classified in the high category, while the ratio of value-added in the processing of coconut shell charcoal is in the medium category. This is in line with Azis's research [18] which states that the ratio of value-added between 15-40% is of medium category, whereas above 40% is classified in the high category.

The large value-added ratio in coconut oil and coconut sugar processing is caused by the value of product output, which is far greater than the value of raw material inputs. This is caused by the contribution of other inputs so that the added value becomes high. However, in the processing of shell charcoal, the value of the product output is not too different from the value of raw materials' input due to the absence of contributions from other inputs. Hence, the added value of the product is also small. The increase in added value can occur due to additional processes in the primary raw material [6].

In addition, the small value-added in shell charcoal processing compared to the other two products is due to the absence of processing technology used in processing. The added value of a product is also influenced by the application of technology in processing [19]. Even so, in terms of business profit margins, the processing of shell charcoal provides a more significant advantage compared to the other two products. This is because the costs incurred for labor processing coconut shell charcoal are much smaller than in processing coconut oil and coconut sugar.

Based on the analysis of the three products' added value, it can be concluded that the processing of coconut commodities can increase the added value of the product. Food processing can provide added value to the products produced [20]. Therefore, it is necessary to increase the processing of coconut commodities into various other derivative products, such as VCO, copra, and so forth. Analysis of value-added VCO has been investigated that the value-added value of VCO in West Aceh was around IDR 2,674.67 per liter [21].

Added value illustrates an industry's ability to create income by increasing the value of commodities through changing forms. Added value in the processing of coconut commodities can also reduce environmental degradation because by-products such as sticks, leaves, and shells can also be utilized [22], [23].

The amount of value added is determined by the value of output, raw material costs, and other input costs. The proportion of labor and benefits to value-added can show whether the business is capital intensive or labor-intensive. In terms of aspects, the agro-industry, coconut oil, coconut sugar, and charcoal industries in Indragiri Hilir are generally still labor-intensive industries that are done with simple technology and small capital. That matter is a major obstacle in developing this coconut agro-industry into a middle and modern industry.

Labor salary is the result of multiplication between the coefficient of labor with the average wage. Labor salary is income earned by labor from each processing of one kilogram of raw material. Labor salary is given for every one-kilogram processing raw material into coconut oil is IDR 647.48 per kg, so the labor share in this business is 85%. Labor salary is given for every one-kilogram processing raw material into coconut sugar is IDR 696.79 per kg, so that the labor share in this business by 67%. The labor salary is given for everyone kilogram of processing raw material into charcoal is IDR 106.58 per kg, so the labor share in this business is 43%. The amount of proportion of this labor share is not reflect the size of the workforce acquisition. This figure only illustrates the balance between the portion of income (labor salary) with the share of income business owner. If the ratio of labor salary to value-added (in percent) is high, then agro-industry can play a role in providing income for its labors. This can solve the problem unemployment through equal employment opportunities [24].

The profit gained by coconut oil craftsmen is IDR 112.52 per kg, with a profit level of 15%. The profit gained by coconut sugar craftsmen is IDR 341.00 per kg, with a profit level of 33%. The profit gained by charcoal craftsmen is IDR 143.40 per kg, with a profit level of 57%. The profit level shows the compensation received by craftsmen for processing coconut oil, coconut sugar, and charcoal.

3) Share of the Owner of Production Factor

It can be seen that the margin obtained from the difference between values output with the price of raw materials in coconut oil processing is IDR 894.37 per kg, the margin in coconut sugar processing is IDR 1,187.79 per kg, and the margin in coconut sugar processing is IDR 249.98 per kg. This margin is then distributed to labor income, other input contributions, and profits effort. The most considerable repayment obtained in the coconut oil processing came from labor's income, which amounted to 72%, which means that labor contributed IDR 72 in every IDR 100 of its margin. The second biggest reward is the contribution of additional input by 15%. This means the contribution of additional input contributes IDR 15 in every IDR 100 margin. The lowest repayment came from the owner profit, which amounted to 13%, which means that the owner contributed IDR 13 in every IDR 100 margin. However, labor in the coconut oil industry is both business owners in this industry.

The most considerable repayment obtained in the coconut sugar processing came from labor's income, which amounted to 59%, which means that labor contributed IDR 59 in every IDR 100 of its margin. The second biggest reward is a profit of the owner by 29%. This means the owner's profit contributes IDR 29 in every IDR 100 margin. The lowest repayment came from the contribution of additional input, which amounted to 13%, which means that additional input contributed to IDR 13 in every IDR 100 margin.

The most considerable repayment obtained in charcoal processing came from the owner's profit, which amounted to 57%, which means that the owner's profit contributed IDR 57 in every IDR 100 of the company's margin. The second biggest reward is labor's income by 43%. This means the labor contributes IDR 43 in every IDR 100 margin. Meanwhile, the contribution of additional input does not contribute to the company's margin. Company's margin is one of the profitability ratios commonly used to measure the

extent to which companies make money. It represents what percentage of sales has turned into profit.

B. Basic Cost (Production Cost) Calculation

Processing of coconut into coconut oil through several stages, namely stripping coir, breaking the shell, prying coconut meat, grating, squeezing coconut milk, and heating coconut milk. It can be calculated that the average raw material used in the three districts for processing coconut oil is 73.67 kg per production, while the output of coconut oil produced is 6.17 kg (Table 2). The average working hours for coconut oil processing is 664 hours per year. Fixed costs per year are IDR 881,358, which consists of the depreciation and capital interest costs. The average non-permanent cost incurred for processing cooking oil in the three districts is IDR 6,993.75 per hour. The average processing capacity is 0.557 kg per hour. Thus, the essential cost of coconut oil processing can be calculated as follows:

$$BP = \frac{\frac{881,358}{664} + 6,993.75}{0.557}$$
$$BP = IDR\ 14,939.13/kg$$

It can be seen that the price of coconut raw material is 529.41, while the price of coconut oil is IDR17,000 per kg (Table 2). This means that the coconut oil processing business is quite profitable because the basic processing cost is smaller than the selling price. The processing of coconut sugar goes through several stages, namely tapping the sap, filtering the sap, cooking the sap, and printing coconut sugar. Based on the data in Table 2, the average fixed cost for processing coconut sugar is IDR 1,082,355 per year, while the average variable costs are IDR 9,859.38 per hour. The average number of hours worked per year is IDR 2,400 per year, while the average processing capacity is 1,208 kg per hour. So the basic costs for processing coconut sugar can be calculated as follows:

$$BP = \frac{\frac{1,082,355}{2,400} + 9,858.38}{1.208}$$
$$BP = IDR\ 8,535.07/kg$$

In Table 2 it can also be seen that the price of raw sap is IDR 500 per kg, while the selling price of coconut sugar is IDR 16,000 per kg. This means that the coconut sugar business is quite profitable because the basic cost for processing coconut sugar is far less than the product's selling price. Based on the data in Table 2, it can be determined that the average fixed cost for processing shell charcoal is IDR 886,350 per year, while variable costs are IDR 13,500 per hour. The average processing capacity of shell charcoal is 31.67 kg per hour. So the basic costs for processing charcoal are as follows:

$$BP = \frac{\frac{886,350}{600} + 13,500}{31.67}$$
$$BP = IDR\ 472.92/kg$$

In Table 2, it can also be seen that the price of shell raw material is IDR 1,000 per kg, while the selling price of shell charcoal is IDR 5,000 per kg. This means that the shell charcoal business is very profitable because the basic costs for processing shell charcoal are much less than the product's selling price.

Based on the calculation of the cost of production, it can be concluded that the three processed products of coconut commodity have a processing cost that is smaller than the selling price. The basic cost of processing is the cost incurred to process one unit of output [12]. If it is associated with processing coconut oil, coconut sugar, and shell charcoal, then the essential processing cost is the cost incurred to produce 1 kg of each processed product.

The cost of processing is influenced by several things, namely fixed costs, variable costs, and the processing capacity of each product. To reduce the processing cost, it can be done by increasing processing capacity or reducing costs, both fixed and variable costs. According to Ref. [25], fixed costs and variable costs incurred for a processing activity can be used to measure or determine the selling price of a product. Therefore, to get a significant profit, it is expected that the cost of processing can be lowered by reducing fixed or variable costs.

IV. CONCLUSION

It can be concluded that the processing of coconut commodities in Indragiri Hilir district can provide an added value. The highest added value is in coconut sugar processing, which is IDR 1,037.79 per kg, while the lowest value-added is in the processing of shell charcoal, which is IDR 249.98 per kg. Meanwhile, the added value of processing in coconut oil is IDR 760 per kg. In calculating processing costs, the smallest cost of processing results obtained in the processing of shell charcoal, which is IDR 472.92 per kg. The highest cost is found in the processing of coconut oil, which is IDR 14,939.13 per kg. Meanwhile, the basic cost of processing (production cost) of coconut sugar is IDR 8,535.07 per kg. However, the three products' production cost is far less than the selling price, so the business is quite profitable. The added value obtained from the coconut agro-industry is very influenced by the production cost used. To obtain added value and large profit, the coconut agro-industry must spend the production costs efficiently.

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