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Value Added Analysis of Strawberries at Each Supply Chain Actor in Nagari Balingka, Agam Regency

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A B S T R A C T

Strawberries are a high-value horticultural commodity with a short shelf life, which results in involvement of multiple actors along their supply chain and differences in value creation. This study aims to analyze the value added of strawberries at each main supply chain actor in Nagari Balingka, Agam Regency. The research was conducted from January to August 2025 using a survey method involving strawberry farmers, collectors, wholesalers, and retailers. Value-added analysis was carried out using the Hayami method to calculate value added, value-added ratio, profit, and profit rate for each actor. The results show that farmers generate the highest value added, ranging from Rp 22,852 to Rp 57,140 per kg with a value-added ratio of 46-88%, which is classified as high. In contrast, collectors, wholesalers, and retailers produce lower value-added, with value-added ratios ranging from 7% to 26%, classified as low to moderate. Differences in value added and profits among actors are influenced by raw material prices, selling prices, and other input costs. Overall, the largest value creation in the strawberry supply chain occurs at the farmer level, while downstream actors mainly function as intermediaries with relatively limited margins.

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 8: Decent Work and Economic Growth
SDG 12: Responsible Consumption and Production

1. INTRODUCTION

1.1. Research Background

Strawberries (*Fragaria* sp.) are a high-value horticultural commodity and are widely favoured by consumers for their attractive colour and taste. Along with advancements in science and technology in the agricultural sector, strawberry cultivation in tropical regions such as Indonesia has continued to increase [1]. According to data from the Central Bureau of Statistics [2], national strawberry production reached 27,721 tons. West Sumatra Province is one of the main strawberry production centers, with Agam Regency having the largest harvested area, particularly in Nagari Balingka, IV Koto District.

As a highly perishable commodity, strawberries have a relatively short shelf life and require proper harvest and post-harvest handling to maintain their quality and freshness until they reach consumers [3]. Strawberries can only last approximately 2-3 days at room temperature and up to 6 days under cold storage conditions [4]. This limited shelf life results in a high risk of damage during distribution, especially in areas where the distance between farms and markets is relatively far and transportation infrastructure is limited.

These conditions indicate that the strawberry distribution process involves various actors with different functions, ranging from farmers to traders at subsequent levels. Each actor in the supply chain performs activities that can create added value by changing the product's form, place, or time. The added value generated by each actor is not always the same, as it is influenced by the types of inputs used, the costs incurred, and the activities performed [5].

Value-added analysis is important for determining the magnitude of each actor's economic contribution in the supply chain and for understanding how the distribution of economic value is formed. This information can be used to describe each actor's role and to serve as a basis for decision-making in the sustainable development of the strawberry business. Therefore,

this study aims to analyze the value added of strawberries at each main actor in the supply chain in Nagari Balingka, Agam Regency.

1.2. Literature Review

Value-added analysis aims to evaluate the contribution of each activity in the supply chain to enhancing a product's value, carried out by all parties involved in the chain [6]. In agricultural commodities, value added increases at each stage of the supply chain, from farmers at the upstream end to consumers at the downstream end. Each actor, including farmers, distributors, retailers, and producers, plays a role in increasing product value, though the level of contribution varies depending on the type of inputs and treatments applied during production [7].

Value added refers to the value created by producers through various production processes or by adding inputs that transform raw materials into products of higher value. This process may involve physical transformation of the product or other actions that enhance the product's utility or value [8]. According to [9] in [5], value added is the result of adding functional inputs to a commodity, which include changes in product form (*form utility*), transferring products to more strategic locations (*place utility*), or storage processes to maintain quality and timeliness (*time utility*). The greater the number of transformations applied to a product, such as processing or more efficient distribution, the higher the value added generated.

From a product perspective, value added represents an increase in a product's value after undergoing a series of processes. In general, the more complex or longer the processes applied to a product, the greater the value added obtained. One commonly used method for analyzing value added is the Hayami method [10]. This method aims to understand how a product experiences value changes throughout the process and how these changes contribute to company profits. The method helps identify the impact of production processes on profits and illustrates how value added is distributed among the various factors of production employed [11].

Identify two main approaches to measuring value added: value added in the production process and value added in the marketing process [12]. In the context of production, there are two categories of factors influencing outcomes: market factors and technical factors. Market factors include factors that affect the final product price, such as raw material prices, labor wages, and the value of other production inputs. Meanwhile, technical factors are directly related to the production process itself, such as production capacity, the quantity of raw materials used, and the labor involved.

1.3. Research Objective

This study aims to analyze the value added of strawberries at each main actor in the supply chain in Nagari Balingka, Agam Regency.

2. MATERIALS AND METHODS

This study was conducted from January to August 2025 in Nagari Balingka, IV Koto District, Agam Regency, West Sumatra Province. The research location was selected purposively because Nagari Balingka is the largest strawberry production center in West Sumatra Province. The main respondents in this study were strawberry farmers in Nagari Balingka, selected purposively with the criteria of being 15-64 years old (productive age according to the Central Bureau of Statistics [13]) and having a minimum of one year of farming experience, so that the respondents were considered to have sufficient experience in strawberry cultivation activities.

In addition to farmers, this study also involved other actors in the strawberry supply chain, including collectors, wholesalers, retailers, and consumers. The selection of supply chain actor respondents was conducted using the snowball sampling technique, namely, identifying respondents based on recommendations from previous respondents until information relevant to the research objectives was obtained. The respondents in this study included 7 strawberry farmers, 3 collectors, 3 wholesalers, and 3 retailers.

The data collection techniques used included field observation, direct interviews with respondents, literature review, and data tabulation to organize and process the collected data. The analysis of strawberry value added for each main actor in the supply chain was conducted using the Hayami method [9]. This method was employed to calculate the magnitude of value added, the value-added ratio, profit, and the distribution of returns to production factors, based on variables such as output, raw material inputs, labor, output prices, and the contribution of other inputs. The value-added calculation using the Hayami method is shown in Table 1.

Table 1. Value Added Calculation Using the Hayami Method

No	Variable	Value
	Output, Inputs, and Prices	
1	Output / total production (kg)	**(a)**
2	Raw material input (kg)	**(b)**
3	Direct labor input (work hours) *(JKO)*	**(c)**
4	Conversion factor	**(d)** = (a)/(b)
5	Direct labor coefficient (work hours/kg) *(JKO/kg)*	**(e)** = (c)/(b)
6	Output price (IDR/kg)	**(f)**
7	Direct labor wage or average wage (IDR/work hours) *(IDR/JKO)*	**(g)**
	Revenue and Profit	
8	Raw material price (IDR/kg)	**(h)**
9	Other input costs (IDR/kg) / Contribution of other inputs	**(i)**
10	Output value (IDR/kg)	**(j)** = (d)*(f)
11	Value added (IDR/kg)	**(k)**= (j) – (h) – (i)
	Value added ratio (%)	**(l)**= (k)/(j)*100
12	Remuneration for direct labor or labor compensation (IDR/kg)	**(m) =** (e)*(g)

The results of the value-added ratio calculation are classified into three categories, namely low (<15%), medium (15-40%), and high (>40%) value added, based on the criteria proposed by Hubeis [14].

Table 1. Value Added Calculation Using the Hayami Method (Continued)

No	Variable	Value
	Share of Direct Labor (%)	**(n)** =(m)/(k)*100
13	Profit (IDR/kg)	**(o)** = (k) – (m)
	a. Profit Rate (%)	**(p)** = (o)/(j)*100
	Returns to Owners of Production Factors	
	Margin (IDR/kg)	**(q)** = (j) – (h)
	a. Direct Labor Compensation (%)	**(r)** = (m)/(q)*100
	b. Contribution of Other Inputs (%)	**(s)** = (i)/(q)*100
	c. Return to the Firm (%)	**(t)** = (o)/(q)*100

3. RESULT AND DISCUSSION

3.1 Value Added of Strawberries at Each Supply Chain Actor

The results of the value-added analysis of strawberries for each supply chain actor in Nagari Balingka indicate differences in value added, value-added ratios, and profits among the actors, namely farmers, collectors, wholesalers, and retailers (Table 2).

Table 2. Range of Value Added, Value Added Ratios, and Profits of Strawberries for Each Supply Chain Actor.

Supply Chain Actors	Value Added (IDR/kg)	Value Added Ratio (%)	Profit (IDR/kg)	Profit Rate (%)
Farmer	22,852-57,140	46-88	6,985-39,275	14-60
Collector	5,293-9,757	9-17	3,293-7,694	6-13
Wholesaller	4,652-23,593	7-26	3,818-22,820	5-25
Retailer	9,919-23,323	10-26	7,419-11,465	8-21

Note: Values are presented as ranges (minimum–maximum) based on the calculation results using the Hayami method [9].

3.1.1 Value Added at the Farmer Level

The value added generated by strawberry farmers ranges from IDR 22,852 to 57,140 per kg, with value-added ratios of 46–88%. Therefore, all farmers fall into the high-value-added category according to Ref. [14] classification. The high value added at the farmer level is attributed to the absence of raw material costs, as strawberries are obtained from their own harvests; consequently, the only deductions from output value arise from other input contributions. Variations in value added among farmers are influenced by differences in output prices and the magnitude of other input contributions. Farmers who receive higher selling prices and incur relatively lower other input contributions generate greater value added and profits. Conversely, high other-input contributions that are not offset by higher selling prices lead to a decline in value added and the profits received by farmers. Farmers' profits range from IDR 6,985 to 39,275 per kg, with profit rates of 14-60%. These differences in profit rates indicate that although all farmers generate high value added, the proportion of value added that can be realised as profit is strongly influenced by the farming operation's cost structure and its allocation to labour compensation. The income and profits of strawberry farmers in Nagari Balingka, Agam Regency, are shown in Table 3.

Table 3. Income and Profits of Strawberry Farmers in Nagari Balingka, Agam Regency.

Variable	PT1	PT2	PT3	PT4
Raw material price (IDR/kg)	0	0	0	0
Other input costs (IDR/kg) / Contribution of other inputs	21,655	7,860	20,729	16,981
Output value (IDR/kg)	65,000	65,000	50,000	57,500
Value added (IDR/kg)	43,345	57,140	29,271	40,519
Value added ratio (%)	67%	88%	59%	70%
Remuneration for direct labor or labor compensation (IDR/kg)	18,859	17,865	8,568	16,803
Share of Direct Labor (%)	44%	31%	29%	41%
Profit (IDR/kg)	24,487	39,275	20,704	23,716
Profit Rate (%)	38%	60%	41%	41%

Note: PT = farmer respondent code.

Table 3. Income and Profits of Strawberry Farmers in Nagari Balingka, Agam Regency (Continued)

Variable	PT5	PT6	PT7
Raw material price (IDR/kg)	0	0	0
Other input costs (IDR/kg) / Contribution of other inputs	27,148	6,544	19,435
Output value (IDR/kg)	50,000	50,000	50,000
Value added (IDR/kg)	22,852	43,456	30,565
Value added ratio (%)	46%	87%	61%
Remuneration for direct labor or labor compensation (IDR/kg)	15,867	18.420	12,926
Share of Direct Labor (%)	69%	42%	42%
Profit (IDR/kg)	6,985	25,036	17,639
Profit Rate (%)	14%	50%	35%

Note: PT = farmer respondent code.

3.1.2 Value Added at the Collector Level

The value added generated by collectors ranges from IDR 5,293 to 9,757 per kg, with value-added ratios of 9-17%, which are classified as low to medium. The low value added at the collector

level is due to the limited difference between purchase and selling prices, resulting in relatively small output value after deducting input costs or other input contributions. In addition, collectors experience volume shrinkage due to sorting activities, as evidenced by conversion factor values below 1. Although other input contributions are relatively small, raw material prices constitute the largest deduction component in the formation of value added. Collectors' profits range from IDR 3,293 to 7,694 per kg, with profit rates of 6-13%, indicating that collectors primarily serve as distribution intermediaries with limited margins. The income and profits of strawberry collectors in Nagari Balingka, Agam Regency, are shown in Table 4.

Table 4. Income and Profits of Strawberry Collectors in Nagari Balingka, Agam Regency.

Variable	PG1	PG2	PG3
Raw material price (IDR/kg)	45,000	50,000	50,000
Other input costs (IDR/kg) / Contribution of other inputs	3,743	3,207	3,875
Output value (IDR/kg)	58,500	5,8500	61,750
Value added (IDR/kg)	9757	5,293	7.875
Value added ratio (%)	17%	9%	13%
Remuneration for direct labor or labor compensation (IDR/kg)	2,063	2,000	2,344
Share of Direct Labor (%)	21%	38%	30%
Profit (IDR/kg)	7,694	3,293	5,531
Profit Rate (%)	13%	6%	9%

Note: PG = collector respondent code.

3.1.3 Value Added at the Wholesaler Level

Wholesalers generate varying levels of value added, ranging from IDR 4,652 to 23,593 per kg, with value-added ratios of 7-26%, which are classified as low to medium. Differences in value added among wholesalers are mainly influenced by variations in output and raw material prices, as well as the magnitude of other input contributions. Wholesalers with higher output prices and more efficient operational costs tend to generate greater value added and profits. Conversely, high other input contributions and low output values result in lower value added and profit rates. Wholesalers' profits range from IDR 3,818 to 22,820 per kg, with profit rates of 5-25%, indicating that the efficiency of the cost structure is a key factor in enhancing profitability at the wholesaler level. The income and profits of strawberry wholesalers from Nagari Balingka, Agam Regency (Table 5).

3.1.4 Value Added at the Retailer Level

The value added generated by retailers ranges from IDR 9,919 to 23,323 per kg, with value-added ratios of 10-26%, which are classified as low to medium. Variations in value added among retailers are influenced by differences in raw material prices, the magnitude of other input contributions, and the output prices received. Retailers who obtain lower raw material prices and relatively higher output prices can generate greater value added and profits, even when other input costs are relatively high. Conversely, high raw material prices and high operational costs lead to lower value added and profit rates. Retailers' profits range from IDR 7,419 to 19,156 per kg, with profit rates of 8-21%, indicating that the ability to control non-labor operational costs is crucial in determining profit levels. The income and profits of strawberry retailers in Nagari Balingka, Agam Regency, are shown in Table 6.

Table 5. Income and Profits of Strawberry Wholesalers from Nagari Balingka, Agam Regency.

Variable	PB1	PB2	PB3
Raw material price (IDR/kg)	60,000	60,000	70,000
Other input costs (IDR/kg) / Contribution of other inputs	6,407	6,598	2,774
Output value (IDR/kg)	90,000	71,250	95,000
Value added (IDR/kg)	23,593	4,652	22,226
Value added ratio (%)	26%	7%	23%
Remuneration for direct labor or labor compensation (IDR/kg)	6,875	6,250	6,875
Share of Direct Labor (%)	3%	18%	7%
Profit (IDR/kg)	22,820	3,818	20,576
Profit Rate (%)	25%	5%	22%

Note: PB = wholesaler respondent code.

Table 6. Income and Profits of Strawberry Retailers from Nagari Balingka, Agam Regency.

Variable	PK1	PK2	PK3
Raw material price (IDR/kg)	65,000	50,000	75,000
Other input costs (IDR/kg) / Contribution of other inputs	7,160	16,677	12,081
Output value (IDR/kg)	85,500	90,000	97,000
Value added (IDR/kg)	13,340	23,323	9,919
Value added ratio (%)	16%	26%	10%
Remuneration for direct labor or labor compensation (IDR/kg)	1,875	4,167	2,500
Share of Direct Labor (%)	14%	18%	25%
Profit (IDR/kg)	11,465	19,156	7,419
Profit Rate (%)	13%	21%	8%

Note: PK = retailer's respondent code.

3.2 Classification of Value Added Levels in the Strawberry Supply Chain

Based on the classification proposed by Hubeis [14] (Table 7), strawberry farmers in Nagari Balingka exhibit high value-added levels, whereas collectors, wholesalers, and retailers fall into the low to medium categories. This difference indicates that the greatest economic value creation occurs at the upstream level, while downstream actors mainly perform distribution functions with relatively smaller margins and value-added ratios.

Table 7. Classification of Strawberry Value-Added Levels Based on Hubeis [14].

Supply Chain Actors	Value Added Ratio (%)	Value Added Category
Farmer	46-88	High
Collector	9-17	Low-medium
Wholesaller	7-26	Low-medium
Retailer	10-26	Low-medium

4. CONCLUSION

The results of the value-added analysis indicate that the value added of strawberries in Nagari Balingka differs across supply chain actors. Farmers generate the highest value added, ranging from IDR 22,852 to 57,140 per kg, with value-added ratios of 46–88%, which are classified as high according to Hubeis' (1997) classification. This is mainly due to the absence of raw material costs and to the relatively efficient use of other inputs. In contrast, collectors, wholesalers, and retailers generate lower levels of value added. The value added of collectors ranges from IDR 5,293 to 9,757 per kg, with value-added ratios of 9–17%. Wholesalers generate value added ranging from IDR 4,652 to 23,593 per kg, with value-added ratios of 7–26%, while retailers generate value added ranging from IDR 9,919 to 23,323 per kg, with value-added ratios of 10–26%. The value-added ratios of collectors, wholesalers, and retailers generally fall into the low to medium categories. Variations in value added and profits among supply chain actors are influenced by differences in raw material prices and selling prices, as well as the magnitudes of other input contributions and operational costs. Overall, the greatest value is added at the farmer level, whereas downstream actors primarily serve as intermediaries with relatively narrow profit margins.

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