

## Comparative Analysis of Production Factor Efficiency of Molded and Crystal Coconut Sugar Businesses in Banyumas Regency

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### ABSTRACT

Coconut sugar agroindustry is one of the important rural economic activities that contributes to household income and local economic development. Differences in production systems between molded coconut sugar and crystal coconut sugar businesses may influence the efficiency of production factor utilization, particularly in the use of sap as the main raw material. This study aimed to identify differences in the efficiency of production factor use between molded coconut sugar and crystal coconut sugar businesses. The research employed a quantitative approach using comparative analysis of production factor use efficiency in both types of businesses. Primary data were collected through interviews and observations of coconut sugar producers. The results showed that the efficiency value of sap utilization in molded coconut sugar businesses was 1.02, while the efficiency value in crystal coconut sugar businesses was 1.03. These findings indicate that both businesses were relatively efficient in utilizing sap as a production factor because the efficiency values were greater than one. However, the efficiency levels were not yet optimal due to unpredictable rainy and dry seasons, which affected the quantity and quality of sap production. Fluctuating weather conditions caused inconsistencies in sap yield and influenced the effectiveness of production activities.

**Keywords:** *Production Factor Efficiency, Molded Coconut Sugar, Crystal Coconut Sugar, Sap Utilization, Comparative Analysis*

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## INTRODUCTION

The agricultural sector plays a strategic role in supporting Indonesia's economic development, particularly through the advancement of agroindustry-based rural economies. Agroindustry contributes significantly to increasing the added value of agricultural commodities, creating employment opportunities, improving rural household income, and strengthening regional economic resilience. One of the agroindustrial commodities with considerable economic potential is coconut sugar, which has become an important source of livelihood for rural communities in several regions of Indonesia.

Banyumas Regency, Central Java, is widely recognized as one of the major coconut sugar production centers in Indonesia. The region possesses abundant coconut resources

and a long-standing tradition of coconut sap tapping and coconut sugar processing activities conducted predominantly by household-scale agroindustries. According to Badan Pusat Statistik (2024), the agricultural sector remains one of the dominant contributors to the regional economy of Banyumas Regency. The publication Banyumas Regency in Figures 2024 reported that agriculture and small-scale agroindustries continue to support employment opportunities and economic activities in rural areas. The publication *Regional Statistics of Banyumas Regency 2024* emphasized that rural agroindustries continue to play a strategic role in supporting economic diversification and community welfare improvement in Banyumas Regency. The agriculture, forestry, and fisheries sector remains one of the leading sectors contributing to regional Gross Regional Domestic Product (GRDP) and labor absorption.

The increasing demand for natural sweeteners in domestic and international markets has encouraged the continuous development of coconut sugar agroindustries. Coconut sugar products are increasingly preferred due to growing consumer awareness regarding healthier and environmentally friendly food products. Crystal coconut sugar, in particular, has attracted wider market attention because of its higher economic value, export potential, and broader industrial applications. This condition has encouraged producers to improve production systems and product quality in order to enhance competitiveness.

Previous studies have highlighted the importance of improving production efficiency and product quality within coconut sugar agroindustries. Dwining et al. (2024) stated that the standardization of production processes is essential to improve the quality and consistency of coconut sugar products. Furthermore, research conducted by Ervina et al. (2020) explained that technological improvements in crystal coconut sugar processing significantly contribute to agroindustrial development and competitiveness in Banyumas Regency. Amelia et al. (2021) also reported that efficient production and marketing systems are important factors in supporting the competitiveness of coconut sugar products in broader markets.

Production factor efficiency is an important indicator in evaluating the performance and sustainability of agroindustrial businesses. Efficient allocation of production inputs enables producers to maximize output while minimizing production costs. However, the efficiency of coconut sugar production is highly dependent on the availability and quality of coconut sap as the primary raw material. In recent years, unpredictable climatic conditions characterized by irregular rainy and dry seasons have become major challenges for coconut sugar producers. Fluctuations in weather conditions affect sap productivity and quality, resulting in unstable production output and limiting the optimal utilization of production factors.

Based on these conditions, an analysis of the efficiency of production factor utilization is necessary to evaluate the performance of coconut sugar agroindustries in Banyumas Regency. The findings of this study are expected to provide empirical information regarding the efficiency level of production factor utilization and contribute to the

formulation of strategies aimed at improving productivity, competitiveness, and sustainability within the coconut sugar agroindustry sector.

## METHOD

This study employed a quantitative approach using a survey method. The survey method was used to obtain factual information and identify existing phenomena through sampling from a population using questionnaires as the primary data collection instrument. The study aimed to analyze the efficiency in the use of production factors of molded coconut sugar and crystal coconut sugar enterprises. The research was conducted in Banyumas Regency. The study location was selected purposively based on the consideration that Banyumas

The research subjects consisted of molded coconut sugar and crystal coconut sugar producers who independently carried out the production process, starting from coconut sap tapping to the final processing stage. The sampling technique used in this study was simple random sampling. Based on the sample size calculation, 65 molded coconut sugar producers and 39 crystal coconut sugar producers were selected as respondents (Nazir, 2022).

The efficiency of production factor utilization in molded coconut sugar and crystal coconut sugar enterprises was analyzed using the economic efficiency approach. Economic efficiency was assessed under the assumption that producers aim to maximize short-term profits. According to Soekartawi (2021), economic efficiency is achieved when the marginal value product of an input is equal to the price of the respective input.

$$\frac{NPM_x}{P_x} = \frac{b \cdot Y \cdot P_y}{X \cdot P_x} = 1$$

Keterangan:

NPM<sub>x</sub> : marginal value product (MVP) of input *x*

P<sub>x</sub> : price of the production factor (Rp)

b : production elasticity coefficient

Y : production output (kg/month)

P : output price (Rp)

X : quantity of sap input (liters/month)

The decision making criteria applied in this study are as follows:

- If  $NPM_x/P_x > 1$  the utilization of production factors in molded coconut sugar and crystal coconut sugar enterprises is considered inefficient and underutilized, indicating that the input usage should be increased.
- If  $NPM_x/P_x = 1$  the utilization of production factors is considered economically efficient or optimal.
- If  $NPM_x/P_x < 1$  the utilization of production factors exceeds the optimal level, indicating overutilization of inputs.

A comparative analysis of production factor utilization efficiency between molded coconut sugar and crystal coconut sugar enterprises was undertaken to determine which

enterprise type exhibits a higher level of efficiency in the allocation and utilization of production factors. Prior to conducting the comparative analysis, a homogeneity of variance test was performed to evaluate whether the variances of the two populations were statistically equivalent. This procedure is essential to ensure the validity of subsequent parametric statistical testing. The homogeneity test applied in this study was formulated according to Sugiyono (2022) as follows:

$$F_0 = \frac{\text{Largest Variance}}{\text{Smallest Variance}}$$

Hypotheses:

H<sub>0</sub> : the two samples have equal variances at the 5 percent significance level.

H<sub>a</sub> : the two samples have different variances at the 5 percent significance level.

Decision Criteria:

- a. Reject H<sub>0</sub> if  $F_0 \leq F_{\alpha}$  at the 5% significance level, indicating that the variances of the two samples are significantly different.
- b. Accept H<sub>0</sub> if  $F_0 > F_{\alpha}$  at the 5% significance level, indicating that the variances of the two samples are not significantly different.

The comparative analysis of production factor use efficiency was conducted to determine the differences in the utilization of production factors between molded coconut sugar enterprises and coconut crystal sugar enterprises using an independent two-sample difference test. The data analysis employed an independent samples t-test using SPSS software. The difference test was applied to examine whether there was a statistically significant difference in the average efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises, as systematically formulated below (Sugiyono, 2022):

Hypotheses:

H<sub>0</sub> : There is no significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.

H<sub>a</sub> : There is a significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.

Statistical Hypotheses:

H<sub>0</sub>:  $NPM_{X1}/P_{X1} = NPM_{X2}/P_{X2}$

H<sub>a</sub>:  $NPM_{X1}/P_{X1} \neq NPM_{X2}/P_{X2}$

Where:

$NPM_{X1}/P_{X1}$  : Average efficiency of production factor utilization in molded coconut sugar enterprises.

$NPM_{X2}/P_{X2}$  : Average efficiency of production factor utilization in coconut crystal sugar enterprises.

Decision Criteria:

- a. If  $t_0 \leq t_{\alpha/2}$  ( $\alpha = 5$  persen),  $H_0$  is accepted, indicating that there is no significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.
- b. If  $t_0 > t_{\alpha/2}$  ( $\alpha = 5$  persen),  $H_0$  is rejected, indicating that there is a significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.

## FINDING AND DISCUSSION

### RESEARCH RESULT

The results of the analysis on the efficiency of production factor utilization in molded coconut sugar and coconut crystal sugar enterprises are presented in Table 1. The analysis specifically evaluates the efficiency of sap (nira) utilization as a production factor in coconut sugar processing during Januari 2026 in Banyumas Regency. The efficiency analysis was measured using the ratio between the Marginal Value Product (MVP) and the input price (Px), where a ratio value close to one indicates that the use of production factors has reached an economically efficient level. The findings provide an overview of the extent to which sap input contributes to the production output and economic performance of both molded coconut sugar and coconut crystal sugar enterprises.

**Tabel 1. Results of the Analysis of Sap (Nira) Production Factor Utilization Efficiency in Molded Coconut Sugar and Coconut Crystal Sugar Enterprises January 2026 in Banyumas District.**

Types of Coconut Sugar	B	Y	Py	X	Px	NPMx/Px
Molded Coconut Sugar	0,164	239,54	11.991	786,01	600	1,03
Coconut Crystal Sugar	0,127	224,54	16.062	765,52	600	1,02

Source: Primary data processed, 2026

Table 1 shows that the value of the sap (nira) production factor in molded coconut sugar and coconut crystal sugar processing were 1.03 and 1.02, respectively. These values are greater than one, indicating that the utilization of sap as a production factor has not yet reached an optimal level. The findings revealed that one kilogram of molded coconut sugar was produced from 3.28 liters of sap, while one kilogram of coconut crystal sugar was produced from 3.41 liters of sap.

Recent studies also reported that coconut sugar production efficiency is highly influenced by the quantity and quality of coconut sap used during processing. Coconut sap serve as the primary raw material in coconut sugar agroindustry, and variations in sap characteristics directly affect sugar yield and production performance. Furthermore, research conducted by Desrial et al. (2025) found that the production of 462,69 kg of

coconut sugar required approximately 2.382.69 liters of sap, indicating the substantial role of sap input in determining production output and added value generation in coconut sugar agroindustry.

Based on the efficiency analysis of sap production factor utilization, the use of sap was found to be not yet optimal. Therefore, an increase in the production factor input, particularly sap, is necessary to achieve maximum profit. In one month of production, coconut sugar artisans produced an average of 239,54 kg of molded coconut sugar from 786,01 liters of sap and 224,54 kg of coconut crystal sugar from 765,52 liters of sap.

The t-test for differences in the mean efficiency of sap utilization as a production factor between molded coconut sugar and crystal coconut sugar enterprises during one production month is presented below:

**Tabel 2. Results of the independent samples t-test analysis on the efficiency of sap utilization as a production factor in molded coconut sugar and crystal coconut sugar enterprises in Banyumas regency, January 2026.**

		Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Production Factor Efficiency	Equal variances assumed	1.368	.245	.069	102	.945	.00308	.04428	-.08474	.09090
	Equal variances not assumed			.074	95.393	.941	.00308	.04156	-.07943	.08558

Source: Primary data processed, 2026.

The analysis of the t-test for differences in the average efficiency of production factor utilization was conducted using an independent samples comparative t-test by comparing the average production factor utilization between molded coconut sugar artisans and coconut crystal sugar artisans.

Hypotheses:

H<sub>0</sub> : There is no significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.

H<sub>a</sub> : There is a significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.

Decision Criteria :

- a. If  $t_0 \leq t_{\alpha/2}$  ( $\alpha =$  persen) H<sub>0</sub> is accepted, indicating that there is no significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.

- b. If  $t_0 > t_{\alpha/2}$  ( $\alpha = 5$  persen)  $H_0$  is rejected, indicating that there is a significant difference in the efficiency of production factor utilization between molded coconut sugar enterprises and coconut crystal sugar enterprises.

Based on the analysis presented in Table 2, the calculated t-value (0,069) was lower than the t-table value (1,98); therefore,  $H_0$  was accepted. This result indicates that there was no significant difference in the efficiency of sap (nira) production factor utilization between molded coconut sugar processing and coconut crystal sugar processing. This condition occurred because the amount of sap produced in both molded coconut sugar and coconut crystal sugar enterprises was relatively similar, and the utilization of sap in both businesses had not yet reached an optimal level.

Recent studies have shown that the efficiency and productivity of coconut sugar agroindustry are strongly affected by the management of raw materials, particularly coconut sap, as the primary production input. The quality, availability, and handling of sap significantly influence production yield, product quality, and production efficiency in both molded and crystal coconut sugar processing systems. Furthermore, traditional processing methods commonly used by small-scale agroindustries in Indonesia are still considered relatively inefficient in terms of production capacity and quality control.

Research conducted by Awami et al. (2025) also emphasized that coconut sugar processing efficiency is influenced by several production factors, including raw material input, labor allocation, and processing management. Their study revealed that optimizing the utilization of production inputs is important for increasing added value and improving agroindustrial performance.

In addition, Yuroh et al. (2021) reported that the technical efficiency level of coconut sugar agroindustry in Indonesia remained relatively moderate, with raw materials, labor, and fuel significantly affecting production output. The study further indicated that inefficient input allocation and traditional production practices were among the major factors limiting agroindustrial efficiency.

These findings indicate that although molded coconut sugar and coconut crystal sugar have different product forms and market characteristics, both agroindustries still face similar challenges related to sap utilization efficiency and production management. Therefore, improving raw material management, increasing sap productivity, adopting better processing technology, and strengthening production efficiency are essential strategies to maximize profit and enhance the competitiveness of coconut sugar agroindustry.

## **DISCUSSION**

The findings of this study indicate that the efficiency values of sap (nira) utilization in molded coconut sugar and coconut crystal sugar enterprises were 1.03 and 1.02, respectively. These values suggest that the utilization of sap as a production factor had not yet reached an optimal level of economic efficiency, although the values were relatively close to one. Furthermore, the results of the independent samples t-test revealed no

significant difference in the efficiency of sap utilization between molded coconut sugar and coconut crystal sugar enterprises. This finding implies that both types of enterprises operated under relatively similar production conditions, particularly with respect to the use of raw materials and production management practices.

The results of this study are consistent with the findings of Badriah et al. (2021), who reported that business efficiency plays an important role in improving the performance of coconut sugar small and medium enterprises (SMEs) in Banyumas Regency. Their study emphasized that efficient allocation and utilization of production inputs contribute significantly to increased productivity and business performance. Similarly, the present study demonstrates that the efficiency of sap utilization remains a critical factor affecting the production performance of both molded coconut sugar and coconut crystal sugar enterprises.

The findings are also in line with the study conducted by Yuroh et al. (2021), which found that the technical efficiency of coconut sugar agroindustry in Pangandaran District had not yet reached optimal conditions due to limitations in production management and input allocation. In the present study, the relatively similar efficiency values between the two types of coconut sugar enterprises indicate that producers still face challenges in maximizing the utilization of sap inputs. One of the factors contributing to this condition is the instability of climatic conditions, particularly unpredictable rainy and dry seasons, which may reduce both the quantity and quality of sap production.

In addition, the findings support the study of Awami et al. (2025), who stated that the added value generated from coconut sugar processing is strongly influenced by production efficiency, raw material quality, and processing techniques. Their study highlighted that improving the management of production factors and maintaining the consistency of raw materials are essential strategies for increasing profitability and value added in coconut sugar enterprises. Likewise, the current study found that the efficiency of sap utilization was closely associated with production outcomes in both molded and crystal coconut sugar processing.

Furthermore, the results of this study are consistent with recent findings reported by Awami et al. (2025), who found that the added value and performance of coconut sugar agroindustry are significantly influenced by production capacity, raw materials, output prices, and production input management. Their study emphasized that efficient utilization of coconut sap as the primary raw material plays an important role in increasing productivity and improving the economic performance of coconut sugar enterprises.

Moreover, Wulandari et al.(2022) emphasized that quality control and effective production management are essential for maintaining product consistency and improving the competitiveness of coconut sugar products. This argument supports the findings of the present study, which indicate that efficient utilization of sap inputs, combined with proper production management, may improve both production efficiency and product quality.

Overall, the findings of this study confirm that the efficiency of sap utilization remains a crucial aspect of the development of the coconut sugar agroindustry. Although the efficiency levels of molded coconut sugar and coconut crystal sugar enterprises were

relatively similar and close to economically efficient conditions, further optimization is still required. Improvements in raw material management, processing technology, and adaptation to climate variability are important strategies for enhancing efficiency, productivity, and profitability in coconut sugar enterprises in Banyumas Regency.

## CONCLUSION

The efficiency of sap (nira) production factor utilization in molded coconut sugar enterprises was 1.02, while the efficiency in coconut crystal sugar enterprises was 1.03. These results indicate that the utilization of sap as a production factor has not yet reached optimal efficiency. This condition was influenced by unpredictable rainy and dry seasons, which affected the quantity and quality of sap produced, resulting in suboptimal production outcomes. In addition, fluctuating weather conditions may reduce sap productivity and consistency, thereby limiting the effectiveness of raw material utilization in the production process. Nevertheless, the efficiency values, which are relatively close to one, suggest that both types of coconut sugar enterprises have approached an economically efficient level in the use of sap as a primary production input.

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