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Economic Value Added of Ant Sugar and Printed Palm Sugar (Arenga pinnata Merr.) in Cikadu District, Cianjur Regency

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Abstract: Indonesian people know palm sugar as one of natural sweeteners, it is used as a supplement to food and drink because it has a distinctive flavor not found in sugar cane. One diversification of palm sugar products is ant sugar. It is a palm sugar in form of a crystal. It is said to be called ant sugar because it looks like an ant house. Process of making it is longer than coconut sugar or palm sugar. This research compared compared it to printed sugar and palm sugar based on socioeconomic conditions and agribusiness income. Samples using Solvin's Formula, 64 ant sugar and 30 scattered sugar farmers' respondents. Conclusions: Value-added ratio of palm sugar businesses is said to be still low but still profitable; Income of palm sugar plantation is difference between income and total production cost and average income is IDR 2,295,537.78 each month; Income of palm sugar cultivation is difference between income and total production cost and average income is IDR 1,135,535.90 each month.

Keyword: Business Income, Farmer, Income, Product, Sugar, Aren.

INTRODUCTION

Sugar production in Indonesia has fluctuated throughout history. In 1930s, Indonesia was once second largest sugar exporting country globally, mainly due to its abundant sugar production from sugar cane. In 2021, Indonesia became world's second-largest sugar-importing country after United States (Cui et al., 2020; Mekse et al., 2025). Rapid population growth and changing consumption patterns have increased demand for sugar in Indonesia (Doni et al., 2026; Handayani et al., 2022). Dependence on sugar imports can also be affected by domestic production factors, such as erratic weather and other factors that affect agricultural output (Arief and Sofyan,2021; Gumono et al., 2023). Sugar production in country is becoming less and less, and sugar imports are increasing at an alarming rate due to increasing public demand for sugar (Gumono et al., 2023; Sutanto & Muljaningsih, 2022).

Indonesian people know palm sugar as one of natural sweeteners in addition to sugar cane (sand sugar) (Alami, 2023; Doni et al., 2026; Klisovi et al., 2024). Palm sugar is usually used as a supplement to food and drink because it has a distinctive flavor not found in sugar cane (Anggraini et al., 2025; Schugmann & Foerst, 2024; Zhuang et al., 2022). Palm sugar is a natural sugar derived from sap of palm family that is cooked to thicken and then printed (Apriliani et al., 2025; Kurniawan et al., 2026). Generally, palm sugar used as raw material for palm sugar in Indonesia comes from coconut milk and palm sugar, so people often refer to palm sugar as coconut sugar, palm sugar, java sugar or printed sugar (Anggraini et al., 2025; Apriliani et al., 2025; Doni et al., 2026; Wiboonsirikul, 2024).

One diversification of palm sugar products is ant sugar (Handayani et al., 2022; Sumartono et al., 2023). An ant sugar is a palm sugar in form of a crystal. It is said to be called ant sugar because it looks like an ant house. Process of making ant sugar is similar to making coconut sugar or palm sugar, but process of making ant sugar is longer, where it thickens for a few minutes and then is then silenced quickly and crushed until grains are formed. After that it's sifted and dried.

Products in form of palm sugar and ant sugar are very safe to consume directly, because in process they do not use chemicals and when viewed from environmental aspects of sugar manufacturing process they do not pollute environment. Therefore, ant sugar is widely used and consumed as a beverage sweetener, a cake sweetener, a hospitality industry, and a soy sauce factory as a mixture of soy sauce making. Today natural/organic foodstuffs are in high demand, because they have a good health impact.

Table 1. Chemical Composition of Palm Sugar, Sugar Cane and Palm Sugar

No.	Chemical Properties of Sugar	Aren (%)	Sugarcane (%)	Simalan Sugar (%)
1.	Water content	9,16	10,32	8,61
2.	Sucrose	84,31	71,89	76,85
3.	A reducing sugar	0,53	3,70	1,66
4.	Fat	0,11	0,15	0,19
5.	Protein	2,28	0,06	1,04
6.	Total Minerals	3,66	5,04	3,15
7.	Calcium	1,35	1,64	0,86
8.	Phosphorus	1,37	0,06	0,01

Sumber: Agricultural Plant Protection Hall Banten (2025)

Ant sugar has opportunity to meet national sugar needs (sweetening ingredients) that have been mostly still imported and also have opportunity to enter overseas markets (exports) such as Singapore, Japan, Hong Kong, USA and Germany. According to market surveys, demand for sugar for exports is very large at around 400 tons each year and has only been met at around 50% of total demand. (Mekse et al., 2025).

Ant sugar in market is sold with various flavors, some natural (natural) flavors, ginger flavors, and so on. Variations in taste of ant sugar have been made in many ways. (Handayani et al., 2022; Ramadhani et al., 2023) states that manufacture of red sugar can be carried out by fortifying vitamin A. Furthermore, it was also explained that shelf life of this sugar is very short, which is about 2 weeks, and sensory property is not preferred by consumers, which is aftertaste (vegetable oil spirit). And sugar has its own advantages: small crystals that dissolve easily in hot water or cold water. Advantage of ant sugar that has 3% water content can be stored for 1 year without preservatives and ant sugar has various grades, namely 10-13 mesh, 16 mesh, and 24 mesh. (Handayani et al., 2022; Ramadhani et al., 2023)

Small industries are many community-managed industries both in rural and urban areas, so this type of industry has potential to be developed as an effort to increase income, for welfare of these industrial actors (Chen et al., 2026; Ebi et al., 2026; Funso, 2025; Rani et

al., 2025). This is certainly found in various regions in Indonesia, including Cikadu District, Cianjur Regency. Cikadu District is an area that has various potential to develop small industries. This is not only because there is support for human resources (Raiten et al., 2026; Taillie et al., 2026), natural resources (Priya et al., 2025; Rose et al., 2026; Terhemba et al., 2024), but more than that, Cikadu District also faces problem of providing jobs that desperately need small industrial development businesses, as a sector that can absorb labor. These various facts suggest that development of small industries in Cikadu District in addition to their role in increasing economic growth and public income. It also has a strategic position in increasing people's income and absorbing labor that has not been absorbed by other sectors of economy.

Efforts to grow small industries are one of efforts that must be carried out by local governments to minimize number of unemployment figures (Samantha, 2026). Especially in Cikadu District, this small industry has potential to be developed, especially in Sugar Aren industry that is participated in in community. Industry, of course, has a vital role in supporting survival and income of people of Cikadu Subdistrict who are involved in Sugar Aren product industry and this is dominant skill possessed by people of Cikadu Subdistrict who have been obtained hereditarily (Handayani et al., 2022).

Cikadu District is one of sub-districts in Cianjur Regency, where there are many Sugar Aren businesses in Cianjur Regency whose account is that area is a quite large producer of Sugar Aren. This industry is classified as a traditional industry in Cikadu District, where around 1,379 people are divided into 10 villages and is main livelihood for their entrepreneurs. Sugar Aren business has independence to increase revenue in an effort to meet economic needs.

Sugar palm production in Indonesia in 2010 was 24,810.55 tons, in 2011 was 20,231.65 tons, in 2012 was 190,844.64 tons, in 2013 was 19,219.29 tons, and in 2014 was 34,241.96 tons (Fact Investment Coordinating Board, 2024). Demand for ant sugar continues to increase over time; this cannot be separated from efforts of ant sugar producers who continue to develop market. Especially for industrial market targets that consider efficiency very much and prioritize practicality over use of regular red sugar. Currently, ant sugar has been widely marketed in several supermarkets, even exported to Australia and Europe, because it is used as a health drink sweetener that has various benefits including preventing bloated stomachs, catching colds, flu, coughs. In addition, ant sugar can last long without addition of preservatives (Mekse et al., 2025).

Improving performance which will maximize business production volume and increase business income (Rukka et al., 2023), compared to printed sugar, ant sugar has several advantages, among them it is more practical to use as food or beverage additives, easily in packaging, storage and transportation. In addition, shelf life of ant sugar is longer because water level is lower than that of printed sugar. In terms of nutritional content, ant sugar has higher levels of protein, fat, calcium, phosphorus, and iron than sugar cane. As for chemical composition of palm sugar, sugar cane and simalan sugar are served in.

METHOD

Type of data in this study was qualitative data and quantitative data. Data sources in this study were primary data obtained directly by interviewing farmers (Putri et al., 2020). Collected data were obtained from various respondents related to study conducted. Determining size of a farmer's sample using a sampling method from Slovin (Samantha et al., 2021)

By formula:

$$n = \frac{N}{1 + Ne^2}$$

Description:
n = Number of samples
N = Total population
e = Fault level tolerance 10 %

Thus, sample size is obtained as follows for 43 palm sugar farmers:

$$n = \frac{43}{1 + 43(0,1)^2} = 30.06 \approx 30$$

Thus, sample size is obtained as follows for 75 palm sugar farmers:

$$n = \frac{177}{1 + 177(0,1)^2} = 63.89 \approx 64$$

Allocation of these sample sizes was above for each village, and each type of respondent used a proportional allocation by formula:

$$n_1 = \frac{N_1}{N} n$$

Description:
n_1 = Number of sample farmers from key group;
n = Large sample size (overall);
N_i = Number of rice paddy farmers in selected village;
N = Total population in District.

RESULT AND DISCUSSION

Condition of Sugar Artisan Aren in Cikadu District

Sugar Aren craftsmen in Cianjur are spread over 10 villages in Cikadu, Padaluyu, Sukaluyu, Mekarlaksana, Cisaranten, Kalapanunggal, Sukamulya, Sukamanah and Mekarjaya villages, but sugar artisans only exist in 2 villages namely Cikadu village and Mekarlaksana.

Ant's sugar

Ant's sugar is first sifted, then sifted back with a smaller sieve, so on and so forth to smallest sieve size. Amount of sugar produced by these three types of smoothness is adjusted according to market demand. Three size sifter sugar is then dried under sun until its water level reaches below 3 percent. If there is no sunlight, drying process can be carried out using a dryer, such as a heating oven. Dried ant sugar is then packaged in sack packs to be delivered to food industry or to large merchants and with plastic packs to market.

Figure 1. Package of Dried Ant Aren Sugar, Packaging

Hardened palm sugar is removed from mold. Next, cold palm sugar is packaged using dried banana leaves or dried palm leaves or plastic.

Figure 2. Package of Printed Aren Sugar

Discussion

1. Sugar Farming Income

Stronger satisfaction level of sugarcane farmers, higher loyalty level of sugarcane farmers will be. Improvement and implementation of genuine partnership services must be provided to people's sugar cane farmers who become partners, such as providing assistance inputs for tractors, irrigation pumps, fertilizers, and seeds for cultivating sugarcane; giving technical guidance and counseling on more modern sugarcane cultivation technology; And sugarcane purchasing system that benefits both parties. (Umaiya et al., 2024)

Considering that there are 30 respondents who were taken (to approach normal distribution). So, there were 94 – 30 respondents to respondents from printed palm sugar farmers is 64 respondents, and 30 ant palm sugar respondents spread in each village.

Table 2. Aren's Sugar Added Value Analysis

No.	Variable	Units	Value	Output, Input and price (n=30) Ant Sugar	Average of Output, Input and price (n=64) Ant Sugar	Output, Input and price (n=30) Printed Sugar	Output, Input and price (n=64) Ant Sugar
I.	Output, Input dan Price						
	1. Output	kg	a	6,413	213.77	12,430	194.22
	2. Raw Materials	Kg	b	8,550.667	285.02	13,084.21	204.44
	3. Workforce	HOK	c	352	11.73	752	11.75
	4. Conversion factor	kg output/kg bahan baku	d = a/b	22.5	0.75	60.8	0.95
	5. Labor coefficient	HOK/kg bahan baku	e = c/b	1.24	0.041443	3.7	0.058
	6. Output price	IDR/kg	f	629,000	20,966.67	771,210	12,050.16
	7. Labor wages	IDR/HOK	g	900,000	30,000	1,895,000	29,609.38
II.	Advantages						
	1. Raw material price	IDR/kg	h	118,600	3,953.33	251,300	3,926.563
	2. Other input contributions	IDR/kg	i	111,650	3,721.67	125,300	1,957.813
	3. Output Value	IDR	j = d x f	471,750	15,725	732,649.5	11,447.65

No.	Variable	Units	Value	Output, Input and price (n=30) Ant Sugar	Average of Output, Input and price (n=64) Ant Sugar	Output, Input and price (n=30) Printed Sugar	Output, Input and price (n=64) Ant Sugar
	4a. Value Added	IDR/kg	k = j – h – i	241,500	8,050	356,049.5	5,563.27
	4b. Value added ratio	%	l = k/j x 100%	1,534.43	51.15	3,106.78	48.54
	5a. A labor cost reward	IDR/kg	m = e x g	37.298.51	1,243.28	109,434.03	1,709.91
	5b. Labor department	%	n = m/k x 100%	463.99	15.46	1,974.04	30.84
	6a. Advantages	IDR/kg	o = k – m	204,201.5	6,806.72	246,615.47	3,853.37
	6b. Profit Level	%	p = o/j x 100%	1,297.346	43.25	2,150.55	33.60
III.	Reply to Production Factors						
	Processing Margin		q = j – h	353,150	11,771.67	481,349.50	7,521.09
	1. a. Labor income	%	r = m/q x 100%	316.58	10.55	1,455.73	22.75
	2. b. other input contributions	%	s = i/q x 100%	950.15	31.67	1,671.19	26.11
	3. c. Corporate Benefits	%	t = o/q x 100%	1,733.269	57.78	3,273.08	51.14
	Monthly Revenue			68,866,133	2,295,538	72,674,297.37	1,135,536

2. Value Addition from Product Diversification

Value-added analysis demonstrates a clear economic advantage of processing palm sap into ant sugar rather than retaining conventional printed form. Value added generated by ant sugar reached IDR 8,050 each kilogram of raw material, compared with IDR 5,563.27 each kilogram for printed sugar. Corresponding value-added ratios were 51.15% and 48.54%, respectively. These results indicate that product diversification does not merely create a different physical form of palm sugar; it changes economic value generated from same raw material. In particular, higher value obtained from ant sugar suggests that additional processing stages, including crystallization, sieving, drying, and product grading, can convert part of raw material into a higher-value marketable product.

This finding is consistent with broader economic role of *Arenga pinnata* in rural livelihoods. Adalina and Sawitri (2021) reported that palm tapping constitutes an important source of income for rural households and emphasized that product diversification, including processing of sap into powdered palm sugar, can increase economic value of resource. Similarly, Apriliani et al., (2025) identified product and value-chain development as an important strategy for improving productivity, competitiveness, and welfare effects of sugar-palm sector, particularly because much of existing industry remains organized at household scale. Present findings provide empirical support for this argument at processing level: moving from a conventional molded product toward a more differentiated crystalline product can increase amount of economic value captured from each kilogram of palm-sap-derived raw material.

Difference in value-added ratio, however, is relatively modest compared with difference in absolute value added. This distinction is economically important. A higher value-added ratio indicates that a larger proportion of output value is retained as value created through processing after accounting for raw material cost, whereas absolute value-added

figure reflects monetary amount generated each unit of raw material. Therefore, higher value added of ant sugar should not be interpreted solely as result of a higher selling price. It also reflects interaction between conversion factors, output price, labor requirements, raw material expenditure, and other processing inputs. Production data in this study show that conversion factors differ substantially between two products, with ant sugar recording 0.75 kg of output each kilogram of raw material and printed sugar 0.95 kg/kg. This difference indicates that economic superiority of ant sugar needs to be understood jointly with processing efficiency rather than from selling price alone.

3. Processing Characteristics and Economic Performance of Ant Sugar

Economic advantage of ant sugar is closely associated with its physical characteristics and processing requirements. Unlike printed sugar, which is directly molded after concentration, ant sugar undergoes further transformation through crystallization, crushing, sieving, and drying. Manuscript's field observations show that product is separated according to particle size and dried until its moisture content is below 3%, after which it is packed for industrial buyers, large traders, or retail markets. These additional operations require more processing effort, but they also create product attributes that may increase marketability.

Importance of moisture control provides one explanation for this economic differentiation. Previous experimental work on ant sugar has shown that moisture content is closely related to product quality and storage characteristics; lower moisture content can contribute to longer shelf life, while excessive moisture increases risk of microbial growth. Ramadhani et al., (2023), whose study specifically examined ant sugar production from *Arenga pinnata* sap using a crystallizer, further demonstrates that crystallization technology is an established route for transforming aren sap into a granular sugar product. More recent work on palm-sugar crystallization also indicates that processing conditions can substantially affect yield and product characteristics, reinforcing importance of process control in determining performance of final product.

From an agroindustrial perspective, these characteristics matter because value creation does not end when sap is converted into sugar. Processing technology determines form, quality, consistency, storability, and market destination of final product. Consequently, ant sugar can be viewed as a form of product upgrading rather than simply an alternative product format. Additional processing stages allow producers to supply a product that is more adaptable to food and beverage applications and easier to package, store, and transport than molded sugar. Current study therefore suggests that economic return from palm sap is influenced not only by availability and price of raw material but also by producer's capacity to undertake downstream processing.

Nevertheless, higher value added should not be interpreted as evidence that all farmers can immediately obtain same economic benefit by switching to ant sugar. Additional processing stages require equipment, labor, technical knowledge, quality control, and access to appropriate markets. Apriliani et al., (2025) similarly identified limited technological knowledge, traditional production practices, and weak industrial development as constraints on competitiveness of sugar-palm sector. Thus, transition from printed sugar to ant sugar represents an economic opportunity, but its realization depends on producer's capacity to manage additional requirements of product upgrading.

4. Income Differences and Economic Implication of Product Diversification

Income results provide a second important dimension of analysis. Average monthly income reported for ant sugar producers was IDR 2,295,538, whereas printed sugar producers obtained IDR 1,135,536. Difference is substantial, with income associated with ant sugar production approximately twice that of printed sugar production. This result strengthens interpretation that diversification toward ant sugar has economic consequences beyond relatively small difference in value-added ratios.

Income differential should, however, be interpreted carefully. Observed difference cannot automatically be attributed to product diversification alone because income is jointly determined by output volume, selling price, production costs, labor use, processing efficiency, and market access. Value-added table itself demonstrates differences in output, raw-material use, labor requirements, conversion factors, and output prices between two processing systems. Therefore, higher income of ant sugar producers is more appropriately interpreted as combined outcome of product characteristics and economic structure of processing activity.

This interpretation is supported by evidence from other sugar-palm production areas. Adalina and Sawitri (2021) found considerable variation in palm-sugar income among farmers and attributed variation partly to number of trees managed as well as technological, environmental, and ecological constraints. Traditional processing techniques were associated with lower product quality and selling prices, while weather conditions affected sap production and sugar drying. Implication for Cikadu is therefore important: increasing income through ant sugar should not be understood simply by changing product form, but as improving efficiency and market orientation of entire processing system.

Results also have implications for distribution of value within rural agroindustry. Processing margin in present study is distributed among labor income, other input contributions, and business benefits. Ant sugar consequently provides an opportunity to increase economic surplus generated from palm sap, but magnitude of that benefit depends on how efficiently producers control processing costs and how effectively they access higher-value markets. In this respect, observed income difference provides an economic argument for encouraging product diversification, while simultaneously highlighting need to strengthen capabilities required to capture that additional value.

CONCLUSIONS

Value-added analysis demonstrates that processing sugar palm sap into ant sugar generates greater economic value than processing it into printed sugar. Ant sugar generated IDR 8,050 of value added each kilogram of raw material, compared with IDR 5,563.27 for printed sugar, while corresponding value-added ratios were 51.15% and 48.54%, respectively. Economic advantage is also reflected in monthly producer income, with ant sugar producers obtaining an average income of IDR 2,295,538, approximately twice IDR 1,135,536 obtained by printed sugar producers. These findings indicate that product through further processing can strengthen economic returns from *Arenga pinnata* sap and provide a stronger basis for upgrading local sugar-palm agroindustry.

Several limitations should be considered when interpreting these findings. First, analysis is based on a specific production and marketing context in Cikadu, and therefore results may not be directly generalized to other sugar-palm production areas with different resource conditions, technologies, input prices, or market structures. Second, study focuses primarily on value added and producer income and does not quantitatively examine other factors that may influence economic performance, such as differences in market access, product quality, processing technology, labor productivity, and producer characteristics. Third, cross-sectional nature of data limit's ability to assess changes in profitability and value added over time, particularly in response to fluctuations in raw-material availability and product prices.

Future research should therefore examine determinants of value added and income using comparative and longitudinal approaches, while incorporating processing efficiency, technology adoption, market access, product quality, and price variability. From a policy perspective, interventions should support appropriate crystallization and drying technologies, quality assurance, packaging, producer organization, and stronger market linkages for ant

sugar. Capacity building and value-chain development are also needed to ensure that additional value created through product diversification is retained more effectively by local producers. Such measures could strengthen competitiveness and sustainability of sugar-palm agroindustry in Cikadu and provide a pathway toward higher and more resilient rural incomes.

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