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THE DYNAMICS OF PRODUCTION COSTS AND VARIANCE PERFORMANCE IN THE OIL PALM INDUSTRY: IMPLICATIONS FOR OPERATIONAL SUSTAINABILITY

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Abstract

This research aims to calculate the Cost of Goods Manufactured (COGM) for Fresh Fruit Bunches (FFB) and analyze the components influencing cost variations at the Adolina Plantation, PT. Perkebunan Nusantara IV Regional II. The study specifically evaluates the gap between actual production costs and planned budgets to determine operational efficiency. A quantitative comparative method was employed, utilizing variance analysis to compare actual work realization against the Work Plan and Budget (RKAP) for the period 2022–2024. Production costs were categorized into direct costs (harvesting, maintenance, and fertilization) and indirect costs (salaries, administration, and depreciation). The results reveal that the average COGM at Adolina Afdeling IV was IDR 1,586 per kilogram. While total nominal production costs decreased following a reduction in operational area, the unit cost showed a constant upward trend—rising from IDR 1,489 in 2022 to IDR 1,648 in 2024. This increase was primarily driven by a sharper decline in production volume relative to cost reductions. Variance analysis identified favorable conditions in 2022 (5.14%) and 2023 (0.39%), whereas 2024 exhibited an unfavorable variance of -0.001% due to increased labor costs and delayed fertilization schedules caused by extreme weather. Despite fluctuations in production volume and climate-related challenges, the plantation maintained a healthy average profit margin of IDR 1,107 per kilogram. The study concludes that controlled cost management is essential to ensuring operational sustainability and economic value in the face of volatile agricultural productivity.

Keywords: Cost of Goods Manufactured (COGM), Fresh Fruit Bunches (FFB), Oil Palm, Variance Analysis, Production Efficiency

1. INTRODUCTION

Oil palm (Elaeis guineensis Jacq) is one of the plantation commodities that generates the largest foreign exchange earnings in the non-oil and gas sector. The output produced consists of edible (consumable) and non-edible (non-consumable) products. The largest edible product produced is cooking oil, while the largest non-edible product produced is fuel oil. In 2022, the area of oil palm plantations in Indonesia was 15.34 million hectares with a production of 46.82 million tons of CPO (Pusat Data dan Sistem Informasi Pertanian, 2024). The price of fresh fruit bunches (FFB) is highly volatile and greatly influenced by the amount of demand and FFB production. Therefore, the price of FFB is closely related to the cost of production. The cost of production is the price of a manufactured good, which includes the cost of materials, labor, and overhead costs. Effective cost management is very important in determining the profitability of a product and the amount of profit earned by a company (Reis et al., 2021; Srivastava & Kirche, 2024) . The accuracy of the calculation of the Cost of Goods Manufactured (COGM) is a crucial element in determining competitive selling prices. For plantation companies, calculating the COGM of Fresh Fruit Bunches (FFB) is essential to ensure optimal profitability. In practice, this calculation can be done using two main approaches, namely full costing and variable costing. Full costing is a comprehensive method for calculating production costs by including all elements of production costs. This method covers raw material costs, direct labor costs, and variable and fixed operating costs. Full costing calculations provide an overview of all costs related to production. This

determines the company's decisions in pricing and profitability analysis (Geiszler et al., 2017). Variable costing, also known as direct costing or marginal costing, is a method of determining production costs that only includes variable costs, which are costs that vary directly with the level of production. This method excludes fixed costs from production costs and treats them as period costs, which are charged to the period in which they occur (Kristensen, 2021). Production Cost Efficiency (HPP) is a fundamental indicator in determining the level of profitability generated from the sale of Fresh Fruit Bunches (FFB). In order for plantation operations to achieve optimal profit margins, HPP values must be managed to remain below the market selling price for the period in question (Mulyadi, 2015). Accuracy in HPP calculations not only serves as the basis for pricing, but also becomes a crucial instrument for management in ensuring the sustainability of plantation operations (Garrison, 2020). This study aims to calculate the cost of production of fresh fruit bunches (FFB) and the components used to calculate the cost of production by the Adolina plantation of PT. Perkebunan Nusantara IV Regional II. The study is expected to find information related to the gap between the actual cost of production and the planned cost of production at the Adolina plantation of PT. Perkebunan Nusantara IV Regional II.

2. Literature Review

Cost is an element that cannot be separated from company activities. Conceptually, cost is understood as the sacrifice of economic resources, both actual and potential, measured in monetary units to achieve certain objectives (Lieberman, 2018). From a broader perspective, costs include all expenditures to obtain goods or services from third parties, whether directly related to the company's main activities or other supporting activities (Cotter, 2022). In the context of oil palm plantations, the accumulation of costs incurred during the production process, such as maintenance, fertilization, pest control, road maintenance, and labor costs, are the main components in calculating the Cost of Goods Sold (COGS). Accuracy in identifying these costs is crucial because it will have a direct impact on inventory value and the determination of an entity's profitability.

Fresh fruit bunch (FFB) production is the yield collected at the collection point and sent to the mill. Three concepts related to oil palm production are Genetic Production, Site Yield Potential, and Actual Production. Genetic production in oil palms refers to the genetic potential of oil palm trees to produce fresh fruit bunches (FFB) and oil. This potential is influenced by the genetic makeup of oil palm trees, which can be improved through breeding programs and genetic studies. For example, genome-wide association studies (GWAS) and quantitative trait locus (QTL) mapping have identified specific genetic markers associated with higher oil yields and other desirable traits (Ithnin et al., 2017). These genetic advances could lead to the development of high-yielding hybrids and clones, which are crucial for improving overall production efficiency (Ernayunita et al., 2025).

Site Yield Potential is the maximum yield that can be achieved under optimal environmental and management conditions. This potential is influenced by factors such as soil quality, climate, and water availability. Studies show that water pressure and rainfall frequency significantly affect FFB yield (Khan et al., 2024). In addition, location-specific factors such as soil type and peat maturity can affect yields, with certain soil conditions being more conducive to higher productivity. Actual production refers to the actual yields obtained from oil palm plantations, which are often less than the genetic and location yield potential due to various limiting factors. These factors include suboptimal management practices, pest and disease attacks, and inadequate fertilization (Euler et al., 2016). Efforts to close this yield gap involve improving agronomic practices, enhancing pest and disease management, and ensuring the use of highquality planting materials (Woittiez et al., 2017).

3. Result and Discussion

PT. Perkebunan Nusantara IV Regional II Kebun Adolina is one of the units located in the Serdang Bedagai Regency, which is a state-owned plantation established in 1926 by the Dutch government and still uses its land for oil palm cultivation. Adolina Plantation consists of 11 divisions, 1 seed garden, and 1 palm oil mill. Seven divisions are located in Serdang Bedagai Regency and the other three divisions are located in Deli Serdang Regency. Division IV has a land area of 858.39 ha, but in 2022 the total land area in Division IV was 1,053 ha. The decrease in hectare area was due to the transfer of operations to Division V amounting to 194.6 ha. Division IV has four different planting years, namely the 2007 planting year with Marihat seedlings consisting of 27 blocks with a total of 57,443 productive plants, averaging 133 plants per hectare. Next is the 2008 planting block, which consists of Socfindo and Marihat seedlings, comprising 9 blocks with a total of 23,798 productive plants, averaging 139 plants per hectare. The 2010 planting year with Socfindo seedlings consisted of 8 blocks with 15,235 Socfindo seedlings, with an average of 140 seedlings per hectare. Finally, the 2017 planting year with KSO Adolina seedlings consisted of 340 seedlings, with an average of 138 seedlings per hectare. Production in Division IV from 2022 to 2024 was far below the targeted work plan, where in 2022 the actual production obtained was 23,916 tons from the production budget work plan of

26,556 tons, a difference of 2,639 tons. In 2023, the Production Budget Work Plan was 21,749 tons, and the actual production was 19,883 tons, a decrease of 1,865 tons. In 2024, the production budget plan is 22,814 tons and the actual production is 18,715 tons, a difference of 4,098 tons. Division IV of the Adolina Plantation has experienced a decline in productivity from 2022 ton 2024, with the decline starting in 2022 from 22.71 tons/ha/year to 18.88, then further declining to 17.77 tons/ha/year in 2024. This data was obtained from the total production in a year divided by the total area in Division IV, where the total production from January to December was divided by the total area of Division IV, which is 1,053 ha. In 2022, fresh fruit bunch (FFB) production was 23,916,090 kg, which decreased by 88% in 2023 to 21,052,710 kg, and in 2024, fresh fruit bunch production decreased again by 90.1% from the previous production. This decline in production was due to a decrease in productivity per hectare from each planting year. The highest production occurred from September to November due to weather factors, where rainfall was very high during those months, while the lowest production was in early January due to a long dry season. This decline in productivity was influenced by several technical and natural factors. In 2022, actual productivity did not reach its maximum potential due to an attack of bagworms that occurred in the previous period. In addition, extreme weather fluctuations , such as a long dry season at the beginning of the year and high rainfall at the end of the year, had an impact on the decline in the number of female flowers (sex ratio) and disrupted the harvesting process.

Production cost analysis: production costs are divided into two components, namely direct costs and indirect costs. The production costs of Division IV in 2022 were below the RKAP (Work Plan and Budget) by Rp 1,390,269,506. In 2023, the realized production costs were below the RKAP by Rp 125,889,869. Meanwhile, in 2024, the realization was above the RKAP with a difference of IDR 430,180. It is known that in 2022, the production cost per hectare of the Adolina plantation in Division IV was IDR 33,684,977 and increased to IDR 38,608,726 per hectare in 2023. In 2024, production costs decreased to IDR 36,913,593 per hectare. Production costs consist of direct and indirect costs. Direct costs are divided into 3 parts, namely harvesting costs, maintenance costs, and fertilization costs. Next are indirect costs, which are divided into six parts, namely employee salary costs, office administration costs, development costs, business travel costs, depreciation costs, and other general costs. In 2022, the total realized production cost was recorded at IDR 35,605,021,340 for an area of 1,053 hectares. This achievement was below the Production Budget Work Plan (RKAP) with an efficiency deviation of 5.14%. Fertilizer costs were the largest direct cost item due to high fertilizer unit prices and volume requirements based on the number of plants. Conversely, travel expenses were the lowest realized component due to their irregular monthly nature. Efficiency during this period was categorized as favorable because actual realization was lower than budget planning.

Entering 2023, there was a decrease in total production costs to IDR 32,253,344,264 due to a reduction in operational area to 858.39 hectares after the transfer of land to other departments. Although total costs decreased, production costs per hectare actually increased significantly to Rp 38,608,726 per hectare compared to the previous year, which was only Rp 33,684,977 per hectare. During this period, harvesting costs experienced unfavorable conditions due to the use of transport trucks that exceeded the budget to handle leftover fruit during high rainfall. However, overall, the variance analysis still showed favorable conditions with a slight deviation of 0.39%. In 2024, the company made efforts to improve efficiency in direct costs to reduce production costs. Production costs during this period reached IDR 30,837,246,946, which was nominally lower than in previous years. However, the variance analysis showed an unfavorable condition of -0.001% because the actual realization slightly exceeded the RKAP. This was triggered by an increase in fertilization costs due to the need for additional labor during extreme weather conditions, where heavy rains forced the postponement of the routine fertilization schedule. Managerially, control over direct costs, especially fertilization, is the most crucial factor because any increase in these costs will be directly proportional to an increase in the cost of production of fresh fruit bunches (FFB).

Cost variance analysis was conducted by comparing the work plan (budget) with actual work realization to evaluate the level of resource efficiency at the Adolina Afdeling IV Plantation. In this context, budget variances are categorized as favorable if the realized costs are lower than the budget, and unfavorable if the realized costs exceed the predetermined budget. In the 2022 period, the variance analysis results showed that the overall condition was favorable with an efficiency rate of 5.14%. This indicates that the plantation management has succeeded in running operations efficiently because the actual cost realization was below the initial budget plan. Although the direct cost category showed favorable performance, there was an anomaly in the office administration cost component, which was unfavorable. This condition was caused by unexpected budget expenditures to meet the needs of assistants and foremen in the field. Entering 2023, variance analysis again shows favorable conditions, but with a much smaller margin of deviation, namely 0.39%. This low percentage reflects the realization of expenditures that are very close to the planned budget limit. During this period, the harvest cost component was recorded as an unfavorable item. Based on the results of the identification, the cost increase in the harvesting sector was triggered by the high volume of leftover fruit that required additional handling compared to the routine work plan. Unlike the previous two years,

the results of the variance analysis for 2024 show unfavorable conditions of -0.001%. Although the deviation is very small, this result shows that actual realization has exceeded the budget plan, meaning that operations during that period were considered inefficient in terms of costs. The main cause of this inefficiency was an increase in fertilization costs. Weather conditions with high rainfall forced the company to delay its fertilization schedule, which ultimately resulted in the use of excess labor when fertilization was resumed. This proves that environmental factors and labor management have a direct impact on the stability of production costs at the plantation level. Calculation of Cost of Goods Manufactured (COGM), Calculating the cost of goods manufactured is a crucial step in evaluating operational efficiency and determining the profitability of a plantation unit. The determination of COGS at Adolina Plantation Division IV is carried out by accumulating all production costs incurred, both direct and indirect, then dividing them by the total volume of Fresh Fruit Bunches (FFB) produced during the relevant period. Based on historical data analysis from 2022 to 2024, the COGS value in Afdeling IV shows a constant upward trend even though the total production costs have decreased in nominal terms. In 2022, with total production costs of IDR 35,605,021,340 and a production volume of 23,916,090 kg, the COGS value was IDR 1,489 per kilogram.

Entering 2023, the HPP increased to IDR 1,622 per kilogram, driven by a sharper decline in production volume compared to the decline in production costs . The upward trend continued into 2024 with the HPP reaching Rp 1,648 per kilogram, which was the highest point during the study period. Overall, the average HPP produced by the Adolina Afdeling IV plantation was Rp 1,586 per kilogram. This annual increase in HPP proves the inverse relationship between production volume and unit cost of production. The lower the TBS production, the greater the fixed and variable costs per unit, thereby increasing the HPP value. The main factors influencing these fluctuations are crop productivity, which is affected by crop age, agroclimatic conditions, and maintenance effectiveness, particularly in terms of fertilization costs, which dominate the direct cost structure. Despite the increase in COGS, the plantation unit was still able to maintain a healthy profit margin. This can be seen from the comparison between the average COGS of Rp 1,586 per kilogram and the average selling price of FFB at the factory, which reached Rp 2,693 per kilogram. Thus, Adolina Afdeling IV Plantation earned an average profit of Rp 1,107 for every kilogram of FFB produced. This condition shows that despite constraints on production volume, relatively controlled production cost management is still able to ensure operational sustainability and provide economic added value for the company.

4. Conclusion

Based on the results of the analysis and discussion of the calculation of the cost of production of Fresh Fruit Bunches (FFB) at the Adolina Plantation of PT. Perkebunan Nusantara IV Regional II, several main conclusions can be drawn. First, the average cost of production generated by the Adolina Afdeling IV Plantation during the research period was Rp 1,586 per kilogram. This value was formed from the accumulation of direct cost components, which included harvesting, maintenance, and fertilization costs, as well as indirect costs, which included employee salaries, office administration, development, business travel, depreciation, and other general costs. Second, the results of the variance analysis show fluctuations in budget efficiency from year to year. In 2022, budget utilization was considered highly efficient with a deviation of 5.14%, indicating favorable conditions as actual costs were below the budget plan. The favorable efficiency trend continued in 2023 with a deviation of 0.39%, although the efficiency margin narrowed. However, in 2024, conditions became unfavorable with a deviation of -0.001%, where actual costs exceeded the budget due to increased fertilization costs triggered by extreme weather conditions.

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