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Effectiveness and Efficiency of Chemical Weed Control in Oil Palm Plantations at Gunung Bayu Plantation

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Abstract

Oil palm (*Elaeis guineensis* Jacq.) is a plantation commodity that requires effective weed management to support the productivity of mature plants. This study aims to analyze the cost of chemical weed control in Afdeling III, Gunung Bayu Plantation, PT Perkebunan Nusantara IV Regional II. The research method used is descriptive quantitative with a case study approach. Data were obtained through observation, interviews, documentation, and company records for 2023–2025, then analyzed by components such as equipment costs, material costs, labor costs, total costs, and costs per hectare. The results indicate that labor costs dominate weed control expenses. The total cost of chemical weed control was Rp 706,386,663 in 2023, Rp 714,956,082 in 2024, and Rp 715,846,890 in 2025, with costs per hectare of Rp 1,034,241/Ha, Rp 1,046,788/Ha, and Rp 1,048,092/Ha, respectively. Changes in material costs, wages, and weed control rotation influenced the increase in costs. Overall, weed control costs in Afdeling III of Gunung Bayu Plantation are relatively stable and can serve as a basis for planning plantation maintenance budgets.

Keywords: Cost, Cost Efficiency, Palm Oil

1. Introduction

Oil palm plantations in Indonesia have grown rapidly and have become a leading commodity that plays a crucial role in the national economy. The continued expansion of plantation areas indicates that oil palm significantly contributes to increasing foreign exchange earnings and employment in the plantation sector (Satriawisti & Parung, 2024). This situation shows that oil palm is a strategic commodity that requires optimal management to maintain productivity. Furthermore, the palm oil industry plays a role in creating jobs, increasing community incomes, and driving regional development, particularly in plantation areas (Restu Hasibuan et al., 2026).In oil palm cultivation activities, one of the important factors influencing production success is plant maintenance, especially weed control. Weeds compete with the main crop for water, nutrients, light, and growing space, thereby inhibiting the growth of oil palm plants. Additionally, weeds can harbor pests and diseases, potentially reducing fresh fruit bunch yields (Sumantri et al., 2024). Therefore, weed control is an integral part of maintaining a productive crop.

Weed control in oil palm plantations is generally carried out chemically using herbicides because it is considered more effective in saving time and labor. However, this method also requires high costs in plantation operating costs. Weed control costs can even reach 30 to 40 percent of the total cost of maintaining a productive crop, making it a significant component of the production cost structure (Nasution et al., 2024). This suggests that weed control costs require closer attention.

In theory, weed control is part of plant cultivation techniques that aim to reduce competition between the main crop and weeds so that plant growth can take place optimally (Saifuddin et al., 2023). The use of herbicides as a chemical method requires attention to the accuracy of the dosage, application time, and its impact on the environment (Santosa et al., 2021). The success of weed control is not only determined by the type of material used but also by the effectiveness of management in the field.

Previous studies have shown that weed control has been widely studied from a technical aspect, but discussions linking the effectiveness of herbicide use with operational cost efficiency are still limited (Saputra et al., 2018). The research focuses more on agronomic aspects

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than on detailed economic analysis. This indicates a need to view weed control through a cost-efficiency lens to optimize plantation management.

Amid fluctuating global palm oil prices, rising production input costs, and increasing demands for sustainable agricultural practices such as RSPO certification, cost efficiency is becoming increasingly important (Tetania, 2024). Therefore, a more in-depth analysis of the cost structure of chemical weed control is necessary to support more informed decision-making in oil palm plantation management (Budi, 2020). Accordingly, this research aims to examine the cost structure of chemical weed control in oil palm plantations in Afdeling III, Gunung Bayu Plantation, PTPN IV Regional II. This study seeks to identify the cost components and the amount of costs incurred in weed control activities, serving as a basis for evaluating the efficiency of plant maintenance management.

2. Research Methods

This research was conducted in Afdeling III of Gunung Bayu Plantation, PT. Perkebunan Nusantara IV Regional II, located in Bosar Maligas District, Simalungun Regency, North Sumatra. *with coordinates LU: 3°5'0" N - 3°15'0" N and BT: 99°19'50" E - 99°28'00" E* at an altitude of about 48 meters above sea level, in May 2026. This study uses a case study approach with a quantitative descriptive method to analyze the cost of chemical weed control in oil palm plantations. This approach is used because the data analyzed is in the form of numerical data, which includes material costs, equipment costs, labor costs, RKAP and realization, rainfall, job rotation, and labor wage data for the period 2023–2025.

Data were obtained through field observations, interviews, and documentation, including plantation profiles, rainfall data, weed control techniques and rotations, and cost data and the RKAP for weed control implementation. The cost data were then processed to obtain cost components consisting of material, equipment, and labor costs.

Next, an analysis of the difference between the RKAP and realization is carried out to determine the cost deviation using the formula:

$$\textbf{Difference} = \textbf{RKAP} - \textbf{Realization.}$$

The cost efficiency level is calculated using the formula:

$$\textbf{Efficiency (\%)} = (\textbf{Realization} / \textbf{RKAP}) \times 100\%.$$

The cost per hectare was calculated to determine the cost burden per area using the formula: cost per hectare = total cost/area (Ha). Data were analyzed descriptively and quantitatively by comparing the RKAP and realization to assess the effectiveness and efficiency of chemical weed control at the research location. The results of the calculation of costs, differences, efficiency, and costs per hectare are used as a basis for evaluating the cost structure of weed control. The research stages include proposal preparation, seminars, location surveys, data collection, data processing, analysis, and preparation of research reports carried out in the period 2025 to 2026.

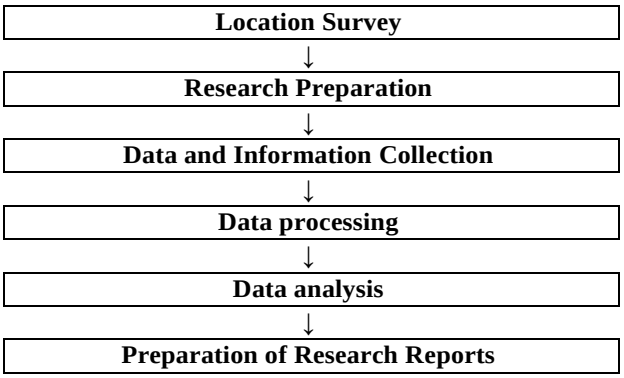


Figure 1. Research Flowchart

3. Results and Discussion

3.1. Description of Research Location

Gunung Bayu Plantation is a business unit of PT Perkebunan Nusantara IV which operates in the oil palm plantation sector (*Elaeis guineensis* Jacq). Initially, a foreign company, NV RCMA from the Netherlands, owned this plantation and developed rubber and oil palm cultivation since 1917. In 1924, a palm oil factory was built to process the produce; then in 1947–1948, the rubber plantations were converted to oil palms.

Following changes in national policy, Gunung Bayu Plantation underwent a nationalization process based on government regulations, resulting in its ownership being transferred to a state asset and evolving into several state-owned plantation companies, ultimately becoming part of PT Perkebunan Nusantara IV. Over time, the plantation and factory units were administratively separated and then merged back into a single operational unit to improve production management efficiency.

In terms of vision and mission, Kebun Gunung Bayu is committed to becoming a superior and globally competitive agribusiness company with a focus on product quality, operational efficiency, human resource development, asset optimization, and social and environmental responsibility. This shows that plantation management is oriented not only toward economic profit but also toward sustainability and community welfare.

Geographically, Gunung Bayu Garden is located at an altitude of approximately 48 meters above sea level in Simalungun Regency, North Sumatra, with flat to hilly topography and soil types of yellow-brown and brown podzolic soil types. The total area is 1,000 m². Reaching 7,739 hectares, divided into 9 divisions, while the research location is in Division III with a total area of 974 hectares in 2024, consisting of various plant categories.

In addition to the oil palm plantation area, which is divided into 9 divisions, Gunung Bayu Plantation also has other areas such as road emplacements, ditches, railways, bridges, ravines, swamps, cemeteries, schools, Hiaten mosques, and waste ponds with a total area of 69,946 Ha in 2024.

Table 1. Oil Palm Plantation Area of Gunung Bayu Plantation 2024

Section	TU (Ha)	TBM (Ha)	TM (Ha)	TTAD (Ha)	Area (Ha)
Division 1	-	-	650	23	673
Division 2	-	-	634	14	648
Division 3	180	98	683	13	974
Division 4	-	50	809	68	927
Division 5	-	-	682	309	991
Division 6	175	143	714	-	1032
Division 7	150	139	544	86	919
Division 8	-	-	787	26	813
Division 9	30	42	690	-	762
Total	535	472	6193	539	7739

Description: TU = Replant, TBM = Plants Not Yet Producing, TM = Producing Plants, TTAD = Plants will not come

Table 2. Other Garden Areas Mount Bayu in 2024

Other Areas	Area (Ha)
Emplacement	7,298
Roads, ditches, rails and bridges	28,818
Ravine/slope/swamp	21,036
Cemeteries, schools and mosques	544
TM repaired (hiaten)	11,700
waste pond	550
Total	69,946

Description: other areas of Gunung Bayu Garden

3.2. Rainfall

Rainfall is an important factor in weed control in oil palm plantations because rainfall data is used to determine plantation maintenance activities. Rainfall information helps plantation management plan work appropriately to optimize production and minimize losses in the palm oil industry.

Table 3. Rainfall Data for Gunung Bayu Plantation 2023-2025

Month	2023		2024		2025	
	CH	HH	CH	HH	CH	HH
January	47	5	65	6	150	14
February	46	4	17	2	151	8
March	183	8	161	9	170	12
April	65	4	89	5	176	11
May	98	7	144	7	86	7
June	86	7	90	7	76	6
July	109	7	122	7	105	5
August	216	12	273	13	183	11
September	243	12	215	14	272	11
October	149	10	236	15	200	11
November	126	8	202	17	263	14
December	170	10	155	9	79	8
Amount	**1,538**	**94**	**1,768**	**111**	**1,910**	**118**

Description: HH = Rainy Day, CH = Rainfall (mm). Source: Gunung Bayu Garden Office

Rainfall in Gunung Bayu Garden during 2023–2025 showed clear monthly fluctuations, with a general pattern of increasing in the middle to end of the year (August–November) and decreasing at the beginning of the year (January–February). In 2023, total rainfall was recorded at 1,538 mm with 94 rainy days, increasing to 1,768 mm with 111 rainy days in 2024, and increasing again to 1,910 mm with 118 rainy days in 2025. This increase indicates a tendency for climate conditions to become wetter from year to year at the research location.

Agronomically, variations in rainfall and rainy days directly affect plant maintenance activities, particularly

weed control in oil palms. High rainfall can accelerate weed growth, increasing the need for more frequent control, while extreme rainfall can also hamper field operations. Therefore, rainfall data is used to determine work rotations and ensure optimal efficiency of plantation maintenance activities throughout the year (Tolik et al., 2023).

3.3. Technical Weed Control Using Chemical Weed Control.

Chemical weed control in Gunung Bayu Garden is carried out using herbicides such as glyphosate and metsulfuron with a knapsack sprayer. This activity is applied to productive crops to control weeds in the disk area, the pikul market, and woody weeds. Weed control in the disk and pikul market is carried out 3–4 times a year at a dose of 500 cc/Ha. Meanwhile, woody weed control is carried out twice a year at a higher dose of 800 cc/Ha using the same type of herbicide to adjust to the weed growth rate.

3.4. Equipment Cost

Based on equipment procurement data, in 2024, eight manual knapsack sprayers were purchased at a unit price of Rp450,000, for a total procurement cost of Rp3,600,000. This procurement is part of the investment cost (capital cost) because it is used to acquire fixed assets with an economic life of more than one year and is used repeatedly in weed control activities. The company procures equipment periodically, every five years, in line with the usage policy and the equipment's economic life.

Table 4. Equipment Usage Costs

Type of tool	Amount (Unit)	Unit Price (Rp)	Total Price (Rp)
Manual knapsack sprayer	8	450,000	3,600,000

Thus, equipment costs only arise in 2024 as an investment realization, while no new procurements were incurred in 2023 and 2025. Compared to other cost components such as labor and materials, equipment costs contribute relatively little to total weed control costs. However, the presence of knapsack sprayers remains important because they support effective herbicide application and ensure smooth field operations throughout the equipment's lifespan (Nizan, 2021).

In this study, equipment costs were not included in the total annual operating costs because the approach used was actual cost, not depreciation. Therefore, recorded costs were based solely on the purchase price at the time of procurement, not on the annual cost spread (Situmorang et al., 2023).

3.5. Material Cost

Chemical weed control work for disks and market baskets is carried out with a rotation of 4 times a year, while chemical weed control for wood is carried out with a rotation of 2 times a year. The active ingredients used in both types of weed control are Glyphosate and Metsulfuron methyl, with a unit price of IDR 51,619 per liter for Glyphosate and IDR 153,206 per kilogram for Metsulfuron methyl (Taufiq, 2024).

The actual cost of chemical weed control in Division III of Gunung Bayu Plantation of PT Perkebunan Nusantara IV was Rp87,418,383. The difference between the budget and the actual cost was due to changes in the number of field rotations, particularly for wood chemical weed control, which increased from the planned 2 to 3 times. This resulted in a difference in costs and active ingredient usage, with the difference being Rp8,465,516 for glyphosate and Rp314,072 for metsulfuron methyl.

Based on the 2024 material cost table, budgeted and actual costs for chemical weed control activities in oil palm plantations differ. Overall, the budget was Rp95,056,220, while actual costs reached Rp95,572,410, resulting in a larger-than-planned difference of Rp516,190.

For the disk and market weed control activities, actual costs were below budget, indicating efficiency. However, for the wood chemical weed control activity, actual costs exceeded the budgeted amount (RKAP), increasing total expenditures. This could be due to differences in weed infestation levels in the field, variations in spraying intensity, and changes in material requirements during the activity (Sumekar, 2022).

In 2025, the rotation of chemical weed-control activities using disks and market pickers will be rotated three times a year, compared with four times in 2023 and 2024. Furthermore, the unit price of glyphosate has also changed from Rp51,619 to Rp51,596 per liter, which also affects the total cost of implementing the activities (Harahap, 2025).

In the chemical weed control activities for disks and pikul markets, the cost realization was recorded much lower than the RKAP. In contrast, in the chemical weed control activities for wood, the realization was actually higher than the RKAP. Overall, total RKAP cost was Rp95,176,458, while total realization reached only Rp81,545,250, resulting in a lower difference from the plan of Rp13,631,208.

3.6. Labor costs

Table 8. Labor Costs in 2023 presents the calculation of labor costs for weed maintenance in oil palm plantations in Afdeling III of Gunung Bayu Plantation of PT. Perkebunan Nusantara IV with an area of 683 ha. The calculation used an activity-based costing (ABC) approach, which allocates costs based on the consumption of weed control activities. This approach does not include the full total labor wage burden, as workers are also involved in other maintenance activities on the farm.

Table 5. *Material Costs for 2023*

Type of work	Rotation	Material	Unit Price (Rp)	RKAP (Usage)	Realization (Usage)	RKAP Price (Rp)	Realized Price (Rp)	Difference (Rp)
Chemical weed control disk and market pick	4	Glyphosate (L)	51,619	1,026	725	52,961,094	37,423,775	15,537,319
Chemical weed control disk and market pick	4	Metsulfuron methyl (Kg)	153,206	26	17	3,929,734	2,632,079	1,297,655
Chemical weed control for wood	2	Glyphosate (L)	51,619	684	848	35,307,396	43,772,912	-8,465,516
Chemical weed control for wood	2	Metsulfuron methyl (Kg)	153,206	21	23	3,275,544	3,589,617	314,072
Total						**95,473,768**	**87,418,383**	**8,055,386**

Table 1 Material Costs for 2024

Type of work	Rotation	Material	Unit Price (Rp)	Use of RKAP	Realization Usage	Price (Rp) RKAP	Price (Rp) Realization	Difference
Chemical weed control disk and market pick	4	Glyphosate (L)	51,619	1,021	725	52,702,999	37,423,775	15,279,224
Chemical weed control disk and market pick	4	Metsulfuron methyl (Kg)	153,206	26	19	3,983,356	2,910,914	1,072,442
Chemical weed control for wood	2	Glyphosate (L)	51,619	681	987	35,152,539	50,947,953	-15,795,414
Chemical weed control for wood	2	Metsulfuron methyl (Kg)	153,206	21	28	3,217,326	4,289,768	1,072,442
Total						**95,056,220**	**95,572,410**	**-516,190**

Table 7. Material Costs in 2025

Type of work	Rotation	Material	Unit Price (Rp)	Use of RKAP	Realization Usage	RKAP Price (Rp)	Realized Price (Rp)	Difference (Rp)
Chemical weed control disk and market pick	3	Glyphosate (L)	51,596	1,021	544	52,679,516	28,080,736	24,598,780
Chemical weed control disk and market pick	3	Metsulfuron methyl (Kg)	153,206	26	14	3,929,734	2,144,884	1,784,850
Chemical weed control for wood	2	Glyphosate (L)	51,596	684	920	35,291,664	47,489,480	-12,197,816
Chemical weed control for wood	2	Metsulfuron methyl (Kg)	153,206	21	25	3,275,544	3,830,150	-554,606
Total						**95,176,458**	**81,545,250**	**13,631,208**

Table 8. Labor Costs in 2023

Type of activity	Norm (US/Ha)	Number of Workers (people)	Area (Ha)	Working days	Wage/US (Rp)	Salary/Labor (Rp)	Cost/Month (Rp)	Cost/Year (Rp)
Chemical weed control disk and market pick	0.3	8	683	26	141,705	3,684,335	29,474,680	353,696,160
Chemical weed control for wood	0.8	6	683	26	141,705	3,684,335	22,106,010	265,272,120
Total							**51,580,690**	**618,968,280**

Operationally, labor costs in this study are calculated using the formula :

BT = (Work norms × Area area × Wages per US × Job rotation)

Where the labor standard (US/ha) indicates the labor requirement per hectare, the area represents the total area worked, the wage per US reflects the labor cost per unit of work, and the rotation indicates the frequency of activities performed in a year. Thus, the results reflect costs allocated only to chemical weed control activities, not the total wages of the plantation workforce.

The wage per US is set at Rp141,705 with 26 effective working days per month, so the average labor salary reaches Rp3,684,335 per month. The work norm for chemical weed control disks and market pickers is 0.3 US /ha with 8 workers, while for wood it is 0.8 US/ha with 6 workers. The rotation of each activity is 4 times per year for disks and market pickers and 2 times per year for wood.

Based on the ABC calculation results, the cost of chemical weed control for disks and market pickers in 2023 was Rp353,696,160, while the cost of wood was Rp265,272,120. The total cost of weed control labor reached Rp618,968,280, which more accurately and proportionally reflects activity-based costs according to the intensity of work in the field (Prasetyo, 2026).

Table 9. Labor Costs in 2024

Type of activity	Norm (US/Ha)	Number of Workers (people)	Area (Ha)	Working days	Wage/US (Rp)	Salary/Labor (Rp)	Cost/Month (Rp)	Cost/Year (Rp)
Chemical weed control disk and market pick	0.3	8	683	26	140,976	3,665,379	29,323,032	351,876,384
Chemical weed control wood - ka yuan	0.8	6	683	26	140,976	3,665,379	21,992,274	263,907,288
Total							**51,315,306**	**615,783,672**

The labor costs for weed control in oil palm plantations in Afdeling III of Gunung Bayu Plantation, PT. Perkebunan Nusantara IV, in 2024, were calculated using the activity-based costing (ABC) approach, a cost allocation method based on the consumption of weed control activities in the field. In this approach, labor costs are not calculated as part of the total full annual salary burden, because labor not only performs chemical weed control activities but is also involved in other maintenance work in the plantation. Therefore, the calculated costs are allocated only to weed control activities based on the work intensity.

Operationally, labor costs are calculated using the following ABC formula:

BT = (Work norm × Area × Wages per US × Job rotation)

Where the labor standard (US/ha) indicates the labor requirement per hectare, the area represents the total work area, the wage per US represents the labor cost per unit of work, and the rotation represents the frequency of activities performed in a year. Thus, the calculation results reflect the actual costs incurred specifically for weed control activities, not the total cost of plantation labor.

The wage per US in 2024 is set at Rp140,976 with 26 effective working days per month, so that the average salary of the workforce reaches Rp3,665,379 per month. The work norm for chemical weed control disks and market pickers is 0.3 US/ha with 8 workers, while for wood it is 0.8 US/ha with 6 workers. Based on the calculation results using the ABC approach, the cost of chemical weed control disks and market pickers is Rp351,876,384 per year, while

the cost of wood is Rp263,907,288 per year, with a total cost of weed control labor in 2024 of Rp615,783,672 (Widiyastuti, 2018).

Table 10. Labor Costs in 2025

Type of activity	Norm (US/Ha)	Number of Workers (people)	Area (Ha)	Working days	Wage/US (Rp)	Salary/Labor (Rp)	Cost/Month (Rp)	Cost/Year (Rp)
Chemical weed control disk and market pick	0.3	8	683	26	145,216	3,775,605	30,204,840	362,458,080
Chemical weed control for wood	0.8	6	683	26	145,216	3,775,605	22,653,630	271,843,560
Total							**52,858,470**	**634,301,640**

The labor costs for weed control in Afdeling III Kebun Gunung Bayu PT. Perkebunan Nusantara IV Regional II in 2025 were compiled using the *activity-based costing (ABC) approach*, which is a cost allocation method based on the consumption of weed control work activities in the field. In this approach, labor costs are not calculated as a total monthly salary expense because labor also carries out other maintenance activities outside of chemical weed control. Therefore, the costs analyzed are only allocated to weed control activities according to the intensity of the work that actually occurs.

Operationally, labor costs are calculated using the ABC formula as follows:
BT = (Work norms × Area × Wages per US × Rotation)

Given that the labor standard (US/ha) indicates the labor requirement per hectare, the area represents the total work area, and the wage per US represents the labor cost per unit of work. The rotation indicates of often the activity in carried out each year; this formula produces a more accurate activity-based cost because it reflects only labor consumption in weed control activities, not the full cost of plantation labor (Wijayani, 2023).

In 2025, wages per US increased to Rp145,216, bringing the labor salary to Rp3,775,605 per month. The labor norm for chemical weed control disks and picket markets is 0.3 US$/ha with 8 workers, while for wood it is 0.8 US$/ha with 6 workers. The rotation of each activity is 3 times for disks and picket markets and 2 times for wood. Based on the ABC approach, the cost of chemical weed control for disks and picket markets is Rp362,458,080 per year, while the cost of wood is Rp271,843,560 per year, so the total labor cost for chemical weed control in 2025 reaches Rp634,301,640.

Table 11. Labor Cost/Ha 2023

Type of activity	Rotation	Norm	Cost per Month (Rp)	Cost per Year (Rp)	Area (Ha)	Cost/Ha (Rp)
Chemical weed control disk & market pick	4	0.3	29,474,680	353,696,160	683	517,857
Chemical weed control for wood	2	0.8	22,106,010	265,272,120	683	388,393
Total	-	-	**51,580,690**	**618,968,280**	683	**906,249**

In 2023, total labor costs for weed control activities were Rp618,968,280, with a cost per hectare of Rp906,249. These costs came from two main types of activities: chemical weed control using disks and pick-up markets, and chemical weed control using wood. Disk and pick-up markets contributed the highest annual cost, at Rp353,696,160, while wood control contributed Rp265,272,120. This difference indicates that disk and pick-up markets require higher labor intensity than wood. Overall, 2023 reflects a labor cost situation that remains stable. Relatively high as a basis for implementing garden maintenance activities in the initial observation period.

Table 12. Labor Cost/Ha 2024

Type of activity	Rotation	Norm	Cost per Month (Rp)	Cost per Year (Rp)	Area (Ha)	Cost/Ha (Rp)
Chemical weed control disk & market pick	4	0.3	29,323,032	351,876,384	683	515,192
Chemical weed control for wood	2	0.8	21,992,274	263,907,288	683	386,394
Total	-	-	**51,315,306**	**615,783,672**	683	**901,587**

In 2024, total labor costs decreased slightly to Rp615,783,672, with a cost per hectare of Rp901,587. This decrease indicates an increase in labor efficiency compared to the previous year, particularly in disk and market activities, which decreased to Rp351,876,384 per year. Meanwhile, woodworking activities also experienced a decrease in costs to Rp263,907,288 per year. Although the decrease is not significant, this indicates improvements in labor management or a reduction in costs. i certain work intensity in the field, so that operational costs become more efficient compared to 2023.

In 2025, total labor costs increased to Rp634,301,640 with a cost per hectare of Rp928,699. The increase primarily influenced this increase in costs for disk and market carrying activities, which reached Rp362,458,080 per year, as well as an increase in wood activities of Rp271,843,560 per year. Compared to the previous year, there was a significant increase, especially in disk activities, indicating an increase in the intensity of weed control or an increase in the need for labor in the field. Overall, 2025 showed a return to increasing labor costs after previously experiencing a decline in 2024, thus indicating fluctuations in labor needs in plantation maintenance activities.

Table 13. Labor Costs/Ha in 2025

Type of activity	Rotation	Norm	Cost per Month (Rp)	Cost per Year (Rp)	Area (Ha)	Cost/Ha (Rp)
Chemical weed control disk & market pick	3	0.3	30,204,840	362,458,080	683	530,685
Chemical weed control for wood	2	0.8	22,653,630	271,843,560	683	398,014
Total	-	-	**52,858,470**	**634,301,640**	683	**928,699**

Table 14. Summary of Total Weed Control Costs for 2023–2025

Cost	Year		
	2023 (Rp)	**2024 (Rp)**	**2025 (Rp)**
Tool		3,600,000	
Material	87,418,383	95,572,410	81,545,250
Labor	618,968,280	615,783,672	634,301,640
Total	706,386,663	714,956,082	715,846,890

The total cost of weed control during the 2023–2025 period shows that the overall realized cost is lower than the RKAP, with a difference of Rp21,170,403. This indicates efficiency in the use of inputs and labor in weed control activities in oil palm plantations during the three years of observation.

4. Conclusion

Based on the results of the research conducted, the conclusions are as follows: The cost of chemical weed control in Gunung Bayu Plantation increased continuously from 2023 to 2025. The costs in 2023 amounted to Rp 1,034,241 per hectare, in 2024 to Rp 1,046,788 per hectare, and in 2025 to Rp 1,048,092 per hectare.

The cost elements of chemical weed control in oil palm producing plants (TM) in Division III of Gunung Bayu Plantation include equipment, material, and labor costs. Total material costs, including the herbicides glyphosate and metsulfuron methyl, reached Rp 246,536,046 over three years. Meanwhile, labor costs totaled Rp 1,869,053,592 over the same period.

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