

THE EFFECT OF ELECTRIC VEHICLE USE ON HARVESTERS' WORK PERFORMANCE AND HARVESTERS' WELFARE IN AFDELING III SEI PUTIH PLANTATION REGIONAL I PTPN IV

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Abstract

This study aims to analyze the effect of Electric Vehicle (EV) use on harvester work performance and welfare in Division 3 of Sei Putih Plantation, Regional 1, PT Perkebunan Nusantara IV. The study used a quantitative approach with a survey method. The study population consisted of all 24 harvesters in Division 3 of Sei Putih Plantation. The sampling technique used saturated sampling so that the entire population became research respondents. Data were collected through questionnaires with a Likert scale, interviews, and documentation. Data analysis was carried out using simple linear regression, partial tests (t-tests), coefficient of determination (R^2), and classical assumption tests including normality and heteroscedasticity tests. The results showed that the use of Electric Vehicles had a positive and significant effect on harvester work performance. The use of EVs can increase the efficiency of Fresh Fruit Bunches (FFB) transportation, reduce physical workload, accelerate work mobility, and help harvesters achieve work targets more optimally. In addition, the use of EVs also had a positive and significant effect on harvester welfare. Improved welfare is shown through increased work comfort, reduced risk of fatigue and injury, and the opportunity for increased income due to increased work productivity. These findings indicate that the application of modern technology in the form of Electric Vehicles can support improved workforce performance and welfare while increasing the operational effectiveness of oil palm plantations.

Keywords: Electric Vehicle, harvester work performance, harvester welfare, work productivity, oil palm plantations.

INTRODUCTION

The application of technology in oil palm harvesting has been proven to increase productivity, work efficiency, and crop quality. Various technological innovations have had a positive impact on increasing fresh fruit bunch (FFB) weight, harvest efficiency, and harvester technical skills. However, technology adoption still faces obstacles in the form of limited training, mentoring, access to information, and capital, resulting in uneven utilization among harvesters (Siregar et al., 2025).

Previous research has shown that harvesters who optimally adopt technology have higher production levels and technical efficiency than those who do not fully implement it. Higher efficiency was also found in groups of harvesters who received support in the form of facilities and coaching compared to independent harvesters (Ariyanto et al., 2020). Consistent with this, the availability of tools and technological support contributes to increased harvester productivity, including through the use of mechanized equipment that can reduce physical workload and improve plantation management effectiveness (Varina et al., 2020).

In addition to technological factors, socioeconomic aspects such as ease of access to technology, work experience, and institutional support also influence improvements in technical efficiency and plantation productivity. This increased productivity ultimately impacts harvester income and welfare (Fitri & Nainggolan, 2023). The use of appropriate technology has also been shown to improve harvest effectiveness, yield quality, and harvester performance in the field, thus categorizing it as a form of mechanization that supports improved harvest performance (Manurung & Wiraguna, 2025). In Division 3 of Sei Putih Plantation, Regional 1, PTPN IV, harvesting activities still face various obstacles, such as delays in FFB transportation, high physical workloads, and fluctuations in harvesters' daily work performance. These conditions have the potential to reduce productivity and

affect harvesters' income and welfare. Therefore, this study was conducted to analyze the effect of Electric Vehicle use on harvesters' work performance and welfare in Division 3 of Sei Putih Plantation, Regional 1, PTPN IV.

THEORETICAL BASIS

Use of Electric Vehicles in Palm Oil Harvesting Activities

Mechanization is the application of technology and equipment to improve work efficiency and reduce reliance on manual labor. On oil palm plantations, mechanization plays a crucial role in accelerating the harvesting and transportation of fresh fruit bunches (FFB), increasing productivity, and lowering operational costs. The use of mechanized equipment has been shown to increase effective working hours and expand harvested areas compared to conventional methods (Campus, 2021).

One form of mechanization that is beginning to be implemented in oil palm plantations is the use of electric vehicles (EVs) as a means of transporting fresh fruit bunches (FFB). The use of electric vehicles can accelerate the mobilization of harvested produce from the block to the harvest collection point (TPH), reduce the physical burden on workers, and increase transport efficiency. Furthermore, the use of EVs is also considered capable of reducing the risk of fatigue and work injuries that often occur with manual transport systems (Siregar et al., 2025).

Previous research has shown that mechanical transport equipment can increase transport capacity, accelerate the FFB evacuation process, and reduce crop losses. Therefore, the use of electric vehicles can be seen as a mechanization innovation that supports increased productivity and operational effectiveness of oil palm plantations (Porawati et al., 2025; Thaddeus et al., 2023).

Harvester Work Performance

Work performance is the results achieved by an individual in carrying out tasks according to established organizational standards. In oil palm harvesting, harvester performance is measured not only by the number of fresh fruit bunches (FFB) harvested, but also by the quality of the harvest, the timeliness of work completion, the level of yield losses, and adherence to standard operating procedures (Mas'ud et al., 2024).

Harvester performance is influenced by various factors, including work experience, skills, motivation, incentive systems, and the availability of work facilities and technology. The application of harvesting technology and mechanization tools can reduce physical workload, enabling harvesters to work more effectively and productively. Therefore, the use of electric vehicles is expected to improve work performance by increasing work time efficiency, reducing fatigue, and increasing the harvester's daily harvest volume (Campus, 2021; Premi et al., 2024).

Harvester Welfare

Well-being is a condition where economic, social, and physical needs are met, enabling individuals to live a decent life. In the context of oil palm plantations, harvester well-being is influenced by income levels, working conditions, health, job security, and access to technology and production facilities (Novel et al., 2024).

Modern welfare approaches emphasize not only income but also quality of life, occupational safety, and opportunities for increased productivity. The application of mechanization technology has been shown to improve worker well-being by reducing physical workloads, enhancing safety, and increasing productivity, which in turn leads to higher incomes (Arum et al., 2023; Wardhana et al., 2024).

The use of electric vehicles as a harvesting aid has the potential to improve harvester welfare by speeding up the work process, increasing harvest volume, reducing the risk of injury, and increasing worker income. Therefore, this technology provides not only operational benefits but also socio-economic benefits for plantation workers (Porawati et al., 2025; Siregar et al., 2025).

RESEARCH METHODS

This research was conducted in Afdeling 3 Kebun Sei Putih Regional 1 PTPN IV, Dolok Masihul District, Serdang Bedagai Regency, North Sumatra, during the period of March–May 2026. The study used a quantitative approach with a survey method to analyze the effect of Electric Vehicle (EV) use on the work performance and welfare of oil palm harvesters. The study population consisted of all 24 harvesters working in Afdeling 3 Kebun Sei Putih Regional 1 PTPN IV. Considering the relatively small population, the sampling technique used was census sampling, so that all members of the population became research respondents. The data used included primary and secondary data. Primary data were obtained through the distribution of questionnaires with a five-

point Likert scale, structured interviews, and direct observations in the field, while secondary data were obtained from scientific journals, company reports, policy documents, and various literature relevant to the research. Prior to the analysis, the research instrument was tested using validity and reliability tests to ensure the feasibility of the measuring instrument. The data analysis technique used was simple linear regression analysis to examine the effect of Electric Vehicle use on harvester work performance and harvester welfare. Hypothesis testing was conducted using a partial test (t-test), while the coefficient of determination (R^2) was used to measure the ability of the independent variables to explain variation in the dependent variable. In addition, classical assumption tests, including normality and heteroscedasticity tests, were conducted to ensure the regression model met the criteria for a good estimator.

RESEARCH RESULT

Data Normality

A normality test was conducted to determine whether the research data was normally distributed. In this study, the Shapiro-Wilk method was used because the sample size was less than 50 respondents.

Table 1. Data Normality Results

Variables	Sig. Shapiro-Wilk	Information
Use of Electric Vehicles (X)	0.088	Normal
Harvester Work Performance (Y1)	0.106	Normal
Harvester Welfare (Y2)	0.625	Normal

Based on the results of the normality test, the significance value (Sig.) of the electric vehicle usage variable (X) was $0.088 > 0.05$, the harvester work performance variable (Y1) was $0.106 > 0.05$, and the harvester welfare variable (Y2) was $0.625 > 0.05$. Since all significance values were greater than 0.05, it can be concluded that the research data were normally distributed.

Heteroscedasticity Test

The results of the heteroscedasticity test using the Glejser test indicate that the significance value of the independent variable is greater than 0.05. This indicates that there are no symptoms of heteroscedasticity, so the regression model is suitable for use.

Table 2. Results of Heteroscedasticity Test

Variables	Sig. (p-value)	Alpha	Information
X against Y1	0.880	0.05	There is no heteroscedasticity
X against Y2	0.319	0.05	There is no heteroscedasticity

The results of the heteroscedasticity test using the Glejser test show that for (X against Y1) a significance value of $0.880 > 0.05$ is obtained so that heteroscedasticity does not occur.

For (X versus Y2), a significance value of $0.319 > 0.05$ was obtained, indicating that heteroscedasticity also did not occur. Thus, the regression model meets the homoscedasticity assumption and is suitable for further analysis.

Simple Linear Regression Analysis

A simple linear regression test is used to determine the effect of the independent variable (X) on the dependent variable (Y).

The Effect of Electric Vehicles (X) on Harvester Work Performance (Y)

Table 3. Results of Simple Linear Regression Analysis

Variables	B	t count	Sig.
Constant	12,798	3,961	0.001
X	0.685	8,485	0.000

Based on the results of the simple linear regression test, the constant value was 12.798 and the regression coefficient was 0.685. Therefore, the resulting regression equation is:

Harvester's Work Performance (Y1) = 12,798 + 0.685X

1. If the variable for electric vehicle use (X) has a value of 0, then the harvester's work performance value is 12.798.
2. Meanwhile, the regression coefficient for the use of electric vehicles is 0.685, indicating that every 1% increase in the use of electric vehicles will increase the harvester's work performance by 0.685.
3. The results of the t-test show that the variable of electric vehicle use (X) on the harvester's work performance variable (Y1) obtained a t_{count} of 8.485 with a significant value of 0.000. $t_{\text{count}} (8.485) > t_{\text{table}} (2.074)$ and a sig. value of $0.00 < 0.05$, so H_0 is rejected and H_a is accepted, which means that the use of electric vehicles has a significant effect on the harvester's work performance.

The Effect of Electric Vehicles (X) on Harvester Welfare (Y)

Table 4. Results of Simple Linear Regression Analysis

Variables	B	t count	Sig.
Constant	7,496	3,050	0.006
X	0.781	12,711	0.000

Based on the results of a simple linear regression test between the use of Electric Vehicles (X) and the welfare of harvesters (Y2), a constant value of 7.496 and a regression coefficient of 0.781 were obtained. Therefore, the resulting regression equation is:

Harvester Welfare (Y2) = 7.496 + 0.781X

1. This means that if the use of an Electric Vehicle is 0, then the harvester's welfare level is 7.496.
2. Meanwhile, the regression coefficient of 0.781 shows that every 1% increase in the use of Electric Vehicles will increase the welfare of harvesters by 0.781.
3. The results of the t-test show that the variable of electric vehicle use (X) on the harvester welfare variable (Y2) obtained a t_{count} of 12.711 with a significant value of 0.000. $t_{\text{count}} (12.711) > t_{\text{table}} (2.074)$ and a sig. value of $0.00 < 0.05$, so H_0 is rejected and H_a is accepted, which means that the use of electric vehicles has a significant effect on the harvester welfare.

Coefficient of Determination

Table 5. Coefficient of Determination

Variable	R Square
The use of electric vehicles (X) on harvester work performance (Y1)	0.766
The use of electric vehicles (X) on the welfare of harvesters (Y2)	0.880

Interpretation:

1. The results of the coefficient of determination test on variable Y1 showed an R Square value of 0.766. This means that the variable of Electric Vehicle usage is able to explain variations in work performance by 76.6%, while the remaining 23.4% is explained by other variables outside the study.
2. The Y2 variable obtained an R Square value of 0.880. This indicates that the use of electric vehicles can explain 88% of the variation in harvester welfare, while the remaining 12% is influenced by other variables outside the study.

DISCUSSION

Based on the research results, the use of Electric Vehicles Electric vehicles (EVs) have a positive impact on harvester performance and well-being. Electric vehicles can increase work effectiveness and efficiency through ease of operation, comfort of use, and support for harvester mobility within plantations. The use of EVs also helps reduce fatigue because they are more practical and easier to operate than conventional vehicles, allowing harvesters to work more focused and optimally to achieve their work targets.

This increased work effectiveness has an impact on the well-being of harvesters. The reduced physical workload provides greater comfort, improves occupational health, and boosts harvester morale in carrying out daily activities. Furthermore, the use of modern technology such as electric vehicles (EVs) creates a safer, more efficient, energy-efficient, and easier-to-maintain work environment, thus supporting the smooth operation of the company.

These findings align with previous research that suggests mechanization and technology utilization in oil palm plantations can increase productivity, reduce physical workloads, and improve worker well-being (Siregar *et al.*, 2025; Porawati *et al.*, 2025). Therefore, the more optimal the use of electric vehicles in plantation operations, the higher the work performance and well-being of harvesters. The results of this study indicate that the application of modern technology in the oil palm plantation sector can provide benefits for workers while supporting increased company productivity.

CONCLUSION

The results of the study indicate that the use of Electric Vehicles (EVs) as operational aids has a positive and significant impact on the work performance and welfare of harvesters in Afdeling 3 Kebun Sei Putih, PT Perkebunan Nusantara IV Regional 1. The use of EVs facilitates the mobility of harvesters in transporting Fresh Fruit Bunches (FFB) from the harvest block to the Result Collection Point (TPH), so that the work process becomes more effective, transport time is more efficient, and physical fatigue can be reduced. This condition has an impact on increasing the productivity and performance of harvesters. In addition, the use of EVs also contributes to improving worker welfare by reducing workload and risk of injury, as well as increasing harvest efficiency which has the potential to increase the daily income of harvesters. Thus, the implementation of Electric Vehicles not only supports improved work performance, but also provides economic benefits and a better quality of life for harvesters.

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