

ANALYSIS OF TRANSPORTATION EFFECTIVENESS AND COST EFFICIENCY ON THE DECISION TO USE *ELECTRIC VEHICLES* IN AFDELING III KEBUN SEI PUTIH REGIONAL I PTPN IV

Wanda Ginanjar¹, Hamzah Manurung^{2*}, Hari Gunawan³

Agribusiness Study Program, Faculty of Science and Technology, Indonesian Palm Oil Institute Field^{1,2,3}

Email: hamzahmanroe@gmail.com^{2*}

Received: 07/08/2026 | Revised: 16/08/2026 | Accepted: 10/09/2026 | Published: 21/09/2026

Abstract

This study aims to analyze the effectiveness of transportation and cost efficiency on the decision to use *Electric Vehicles* (EVs) in operational activities in Afdeling III of Sei Putih Plantation, Regional I, PTPN IV. The study used a quantitative descriptive method with the research location at Sei Putih Plantation, Regional I, PTPN IV, Serdang Bedagai Regency, North Sumatra. The study population consisted of all parties directly involved in operational transportation management, cost evaluation, and EV use, with a total of 7 people. The sampling technique used saturated sampling (*total sampling*) so that the entire population became respondents. Data were collected through Likert-scale questionnaires, field observations, interviews, and documentation. Data analysis was carried out using quantitative descriptive analysis through the calculation of average scores, frequencies, and percentages. The results showed that the effectiveness of EV transportation obtained an average value of 4.44 which is included in the strongly agree category, indicating that EVs are able to support work mobility, increase productivity, and facilitate plantation operational activities. The cost efficiency variable obtained an average value of 3.88 which is included in the agree category, indicating that the use of EVs can provide operational cost savings and has the potential to generate long-term economic benefits. Meanwhile, the decision to use EVs received an average score of 4.69, which falls into the strongly agree category, indicating a high level of acceptance and feasibility of using EVs in plantation operations. In addition to providing operational and economic benefits, EV use also supports corporate sustainability efforts by reducing reliance on fossil fuels and implementing environmentally friendly transportation. Therefore, *electric vehicles* have the potential to be an effective, efficient, and sustainable means of operational transportation in the palm oil plantation sector.

Keywords: *Electric Vehicle*, transportation effectiveness, cost efficiency, usage decisions, oil palm plantations.

INTRODUCTION

The development of environmentally friendly transportation technology continues to accelerate in line with efforts to reduce carbon emissions and transition to sustainable energy. One rapidly developing innovation is *the Electric Vehicle* (EV), which is considered more energy efficient, has lower operating costs, and is more environmentally friendly than fossil-fueled vehicles. The Indonesian government also supports the acceleration of electric vehicle adoption through Presidential Regulation No. 55 of 2019 as part of the national energy transition strategy (Damanik et al., 2025).

In the oil palm plantation sector, transportation plays a crucial role in supporting workforce mobility and field operations. PTPN IV Regional I Kebun Sei Putih has implemented the use of Hangbang three-wheeled electric vehicles (EVs) in Afdeling III to improve transportation efficiency and reduce operational costs (Astuti & Susanto, 2024). However, EV use still faces various challenges, such as plantation road conditions, vehicle capacity, and the readiness of supporting infrastructure. Therefore, further analysis of the transportation effectiveness and cost efficiency of EV use is needed based on user experience in the field (Afraah et al., 2025).

Transportation effectiveness reflects the ability of EVs to support operational smoothness through ease of use, mobility, work productivity, and energy efficiency. Meanwhile, cost efficiency relates to savings in energy, operational, and vehicle maintenance costs (Liu et al., 2021). Research on EV use in plantation operations is still relatively limited compared to public transportation and private vehicles, creating a *research gap* that needs to be

addressed. Therefore, this study aims to analyze the influence of transportation effectiveness and cost efficiency on the decision to use *electric vehicles* in Division III of Sei Putih Plantation, Regional I, PTPN IV (Toglaw et al., 2026).

THEORETICAL BASIS

Electric Vehicle (EV)

An *Electric Vehicle (EV)* is a vehicle that uses electricity as its primary power source. The use of EVs is growing rapidly as an environmentally friendly transportation solution due to its ability to reduce carbon emissions, increase energy efficiency, and lower operational costs compared to fossil-fueled vehicles (Damanik et al., 2025). In Indonesia, the development of electric vehicles is supported by Presidential Regulation Number 55 of 2019 concerning the Acceleration of the Battery-Based Electric Motor Vehicle Program as part of the national energy transition policy.

The decision to use an EV is influenced by various factors, including energy efficiency, operational costs, ease of use, availability of supporting infrastructure, and the environmental benefits of electric vehicles (Astuti & Susanto, 2024). In the plantation sector, EV use is also influenced by field operational conditions, work mobility needs, and the vehicle's ability to support company operations (Afraah et al., 2025).

Transportation Effectiveness

Transportation effectiveness is the ability of a means of transportation to optimally support smooth operational activities, thereby achieving organizational goals. In the context of EV use, transportation effectiveness indicates the extent to which electric vehicles can improve work mobility, accelerate operational activities, and provide ease of use (Liu et al., 2021).

Factors that influence transportation effectiveness include:

1. Ease of use of the vehicle.
2. Speed and smooth mobility.
3. The productivity of the work produced.
4. Efficient use of energy.
5. Suitability of the vehicle to field operational conditions.

The higher the effectiveness of transportation perceived by users, the greater the benefits obtained by the company in supporting daily operational activities (Afraah et al., 2025).

Cost Efficiency

Cost efficiency is an organization's ability to maximize operational benefits with minimal costs. For electric vehicles, cost efficiency can be seen in savings on energy, operational, and maintenance costs, as well as reduced long-term vehicle operating costs (Liu et al., 2021).

Factors that influence cost efficiency include:

1. Energy costs or electricity charging.
2. Daily operating costs.
3. Vehicle maintenance and repair costs.
4. Economic life of the vehicle.
5. Long-term cost savings compared to conventional vehicles.

According to Astuti and Susanto (2024), cost efficiency is one of the main considerations for companies in adopting electric vehicles because it is directly related to efforts to increase operational efficiency and reduce company expenses.

Decision to Use *Electric Vehicles*

The decision to use an *electric vehicle* is an individual or organization's decision to utilize electric vehicles as a means of transportation for operational activities. This decision is based on consideration of the benefits, both operationally and economically (Astuti & Susanto, 2024).

Factors influencing the decision to use an EV include:

1. The effectiveness of transportation perceived by users.
2. Operational cost efficiency.
3. Ease of use of the vehicle.
4. Availability of supporting infrastructure.

5. Environmental benefits and sustainability.
6. Government policy support for the use of electric vehicles.

In the plantation sector, the decision to use electric vehicles is influenced by the vehicle's ability to support fieldwork mobility while simultaneously reducing company operational costs (Afraah et al., 2025). Therefore, transportation effectiveness and cost efficiency are critical factors in determining the success of electric vehicle implementation in plantation operations (Toglaw et al., 2026).

RESEARCH METHODS

The research method used is quantitative descriptive research that aims to describe the effectiveness of transportation, cost efficiency, and the decision to use *Electric Vehicles* (EVs) in operational activities at Sei Putih Plantation, Regional I, PTPN IV. The research was conducted at Sei Putih Plantation, Regional I, PTPN IV, in Dolok Masihul District, Serdang Bedagai Regency, North Sumatra, during the period of March to May 2026. The research population consisted of all parties directly involved in the management of operational transportation, cost evaluation, and EV use, with a population of 7 people. Considering the relatively small population, this study used a saturated sampling technique (total sampling) so that all members of the population became respondents. Respondents included the Plantation Manager, Assistant Head, Afdeling Assistant, transportation staff, administrative/financial staff, and harvest foremen who have knowledge and direct involvement in the use of EVs. The data used consisted of primary and secondary data. Primary data was obtained through Likert-scale questionnaires, field observations, and interviews, while secondary data was obtained from company documents, EV usage data, company profiles, and various relevant scientific literature and references. Data collection techniques included distributing closed-ended questionnaires, field observations, and documentation studies. Furthermore, the data were analyzed using quantitative descriptive analysis through editing, coding, data tabulation, and calculating scores, frequencies, percentages, and averages (*means*) to illustrate respondents' perceptions of transportation effectiveness, cost efficiency, and the decision to use *electric vehicles* in plantation operations.

RESEARCH RESULT

Results of Analysis of Transportation Effectiveness Variable (X1)

Operational Ease

Operational ease indicates the level of ease of use of *Electric Vehicles* in supporting operational activities in Afdeling III Kebun Sei Putih.

Table 1. Operational Ease

Answer Categories	Frequency
Strongly agree	5
Agree	2
Neutral	0
Don't agree	0
Strongly Disagree	0

The mean value of the operational ease indicator is 4.67 . Based on the score interpretation category, this value is in the interval 4.21–5.00, so it is included in the Strongly Agree category .

These results show that *Electric Vehicles* are easy to use by operators and are able to support plantation operational activities effectively.

Mobility Speed

Mobility speed shows the EV's ability to accelerate the movement and transportation of crops in the field.

Table 2. Mobility Speed

Answer Categories	Frequency
Strongly agree	4
Agree	3
Neutral	0
Don't agree	0
Strongly Disagree	0

The average mobility speed indicator score was 4.64 , falling into the Strongly Agree category . This indicates that EV use can improve work mobility and accelerate operational activities in the field.

Work Productivity

Work productivity shows EV's ability to improve work results and work execution efficiency.

Table 3. Work Productivity

Answer Categories	Frequency
Strongly agree	4
Agree	3
Neutral	0
Don't agree	0
Strongly Disagree	0

The average work productivity indicator score was 4.64, falling into the Strongly Agree category. Respondents assessed that the use of EVs helps increase work productivity, particularly in the transportation of fresh fruit bunches (FFB).

Energy Usage Effectiveness

Energy efficiency indicates the EV's ability to utilize energy efficiently for operational activities.

Table 4. Energy Usage Effectiveness

Answer Categories	Frequency
Strongly agree	2
Agree	4
Neutral	1
Don't agree	0
Strongly Disagree	0

The average value of the energy effectiveness indicator was 3.81 , falling into the "Agree" category . This indicates that respondents considered the use of electrical energy in EVs to be quite effective in supporting plantation operations.

Recapitulation of Transportation Effectiveness Variables

Table 5. Recapitulation of Transportation Effectiveness variables

Indicator	Mean	Category
Operational Ease	4.67	Strongly agree
Mobility Speed	4.64	Strongly agree
Work Productivity	4.64	Strongly agree

Energy Usage Effectiveness	3.81	Agree
Mean of Variable X1	4.44	Strongly agree

Overall, the transportation effectiveness variable obtained an average value of 4.44, which is included in the Strongly Agree category.

Results of Cost Efficiency Variable Analysis (X2)

Maintenance Costs

The average value of the maintenance cost indicator is 3.71 with the Agree category. These results indicate that EV maintenance costs are considered relatively more efficient than conventional means of transportation.

Operating costs

The average value of the operational cost indicator is 3.93 with the Agree category . Respondents assessed that the use of EVs could reduce daily operational costs.

Long Term Savings

The average value of the long-term savings indicator is 4.00 with the Agree category . This shows that EVs have the potential to provide long-term economic benefits.

Recapitulation of Cost Efficiency Variables

Table 6. Recapitulation of Cost Efficiency Variables

Indicator	Mean	Category
Maintenance Costs	3.71	Agree
Operating costs	3.93	Agree
Long Term Savings	4.00	Agree
Average of Variable X2	3.88	Agree

Overall, the cost efficiency variable obtained an average value of 3.88 with the Agree category .

Results of the Analysis of the Decision Variable for Using *Electric Vehicles* (Y)

Interest in EV Use

The average value of the EV interest indicator was 4.67, falling into the Strongly Agree category . This indicates that respondents have a high level of interest in using EVs in plantation operations.

EV Readiness

The average EV readiness indicator score was 4.62, falling into the Strongly Agree category . This result indicates that companies and users are considered ready to operate EVs.

EV Usage Eligibility

The average value of the EV feasibility indicator was 4.79 , which falls into the Strongly Agree category . Respondents assessed that EVs are suitable for operational transportation in the Kebun Sei Putih Division III.

Recapitulation of EV Usage Decision Variables

Table 7. Recapitulation of EV Usage Decision Variables

Indicator	Mean	Category
Interest in EV Use	4.67	Strongly agree
EV Readiness	4.62	Strongly agree
EV Usage Eligibility	4.79	Strongly agree
Average of Variable Y	4.69	Strongly agree

Overall, the decision variable for using *Electric Vehicles* obtained an average value of 4.69, which is included in the Strongly Agree category .

DISCUSSION

Effectiveness of Electric Vehicle Transportation in Plantation Operations

The results of the study indicate that the use of *Electric Vehicles* (EVs) in Afdeling III of Sei Putih Plantation, Regional I, PTPN IV received a very good rating with an average score of 4.44. These results indicate that EVs are able to support the smooth operation of the plantation through ease of use, increased mobility, increased work productivity, and relatively efficient energy use. The high ratings for aspects of operational ease, mobility speed, and work productivity indicate that EVs are able to accelerate the process of transporting harvested crops and reduce the physical workload of employees. This finding is in line with research by Aksyani et al. (2025) and Bagas Anugrah Herviandinata et al. (2025) which stated that transportation effectiveness plays an important role in supporting the smooth operation of oil palm plantations.

Cost Efficiency of Electric Vehicles in Plantation Operations

The cost efficiency variable obtained an average value of 3.88, indicating that the use of EVs is considered capable of providing operational cost savings. Maintenance and operational costs for electric vehicles are considered lower than those of conventional vehicles. This finding is supported by operational data showing an average electricity cost of IDR 274,190 per month during the period October 2025–April 2026. Although the long-term economic benefits have not been fully realized due to the relatively short usage period, EVs show good potential in improving the efficiency of companies' operational costs. The results of this study support the findings of Astuti and Susanto (2024) and Domagała and Kadłubek (2023) who stated that energy efficiency and operational costs are important factors in the adoption of electric vehicles.

Decision to Use Electric Vehicles in Plantation Operations

The decision to use EVs achieved the highest average score of 4.69, indicating a very high level of acceptance of electric vehicles in plantation operations. The high level of interest in use, operational readiness, and perceived feasibility of EV use indicate that electric vehicles have been able to meet transportation needs in plantation environments. This finding aligns with research by Riedner et al. (2018), which states that experience using electric vehicles can increase positive perceptions and acceptance of the technology.

The Contribution of Electric Vehicles to the Sustainability of Plantation Operations

In addition to providing operational and economic benefits, the use of electric vehicles also contributes to the sustainability of the palm oil industry. Utilizing electricity as a primary power source has the potential to reduce dependence on fossil fuels, reduce exhaust emissions, and support the national energy transition program. Therefore, the implementation of electric vehicles in Sei Putih Plantation's Division III not only improves transportation effectiveness and cost efficiency but also supports the implementation of *green transportation concepts* and sustainable plantation practices.

CONCLUSION

Based on the results of the study on the analysis of transportation effectiveness and cost efficiency on the decision to use *Electric Vehicles* (EVs) in Afdeling III Kebun Sei Putih Regional I PTPN IV, it can be concluded that the use of EVs can provide positive benefits for plantation operations. The effectiveness of EV transportation is classified as very good with an average value of 4.44 which is in the strongly agree category. These results indicate that EVs are able to support Fresh Fruit Bunches (FFB) transportation activities, improve work mobility, and increase operational productivity. On the other hand, the cost efficiency of EV use is also considered good with an average value of 3.88 which is included in the agree category. These findings indicate that the use of EVs has the potential to reduce operational and maintenance costs and provide long-term economic benefits compared to conventional transportation means.

Furthermore, the decision to use EVs achieved a very high level of acceptance, with an average score of 4.69, which falls into the strongly agree category. These results indicate that respondents have a high level of interest, readiness, and confidence in the feasibility of using EVs to support plantation operations. Overall, the use of EVs not only improves transportation effectiveness and cost efficiency, but also contributes to corporate sustainability by reducing dependence on fossil fuels and supporting the implementation of environmentally friendly transportation in the palm oil plantation sector. Thus, EVs have the potential to continue to be developed as an effective, efficient, and sustainable means of operational transportation in plantation environments.

REFERENCES

- Afraah, S. M., Yuniaristanto, Y., Sutopo, W., & Hisjam, M. (2025). Comparing total cost of ownership conventional motorcycles in Indonesia of electric. 22(2), 196–210.
- Aksyani, F. F., Purboseno, S., & Yomo, S. A. (2025). Evaluation of efficiency and carbon emissions of fresh fruit bunches (FFB) transportation by company and contractor dump trucks in a low carbon development framework. 5(1), 136–141.
- Astuti, R. D., & Susanto, A. A. (2024). Challenges of electric vehicle adoption in Indonesia: Revealing the hidden factors affecting purchase intention. *Jurnal Siasat Bisnis*, 28(2), 149–171. <https://doi.org/10.20885/jsb.vol28.iss2.art2>
- Damanik, N., Saraswani, R., & Hakam, D. F. (2025). *A comprehensive analysis of the economic implications, challenges, and opportunities of electric vehicle adoption in Indonesia*.
- Domagała, J., & Kadłubek, M. (2023). Economic, energy and environmental efficiency of road freight transportation sector in the EU. *Energies*, 16(1). <https://doi.org/10.3390/en16010461>
- Lazuardy, A., Nurcahyo, R., Kristiningrum, E., & Ma, A. (2024). Technological, environmental, economic, and regulation barriers to electric vehicle adoption: Evidence from Indonesia, 1–14.
- Liu, Z., Song, J., Kubal, J., Susarla, N., Knehr, K. W., Islam, E., Nelson, P., & Ahmed, S. (2021). *Comparing total cost of ownership of battery electric vehicles and internal combustion engine vehicles* (pp. 1–41).
- Riedner, L., Mair, C., Zimek, M., Brudermann, T., & Stern, T. (2019). E-mobility in agriculture: Differences in perception between experienced and non-experienced electric vehicle users. *Clean Technologies and Environmental Policy*, 21(1), 55–67. <https://doi.org/10.1007/s10098-018-1615-2>
- Toglaw, S., Ahmad, A. Al, & Salem, Z. (2026). Value-based encroachment strategy for electric and autonomous vehicles: Evidence from Kuwait, 1–18.