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The Influence Of Perceived Benefits, Ease Of Use, And Farmer Trust On Agricultural Electrification

Agus Susilo[1], Suswadi[2], Nobertus Citra Irawan[3]

[1,2,3] Tunas Pembangunan University, Jl. Balekambang Lor No.1 Manahan, Banjarsari, Surakarta, 57139
Corresponding Email: irawan@lecture.utp.ac.id

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Abstract

This research is motivated by the high dependence of rice farmers in Boyolali Regency on diesel-fueled water pumps, which causes high operational costs and production instability due to fluctuations in fuel prices. Agricultural electrification through the use of electric pumps is a more efficient and sustainable alternative, but its adoption rate is still relatively low. This study aims to analyze the influence of Perceived Benefits, Ease of Use, and Farmer Trust on the Adoption of Agricultural Electrification. The study used a quantitative approach with a descriptive-analytical method. The study population was all rice farmers who had used or had access to electric pumps in Giriroto Village, Ngemplak District, and Babadan Village, Sambi District, Boyolali Regency. The study was conducted from December 2025 to January 2026. Primary data were collected through a Likert-scale questionnaire and analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The results showed that Perceived Benefits and Ease of Use had a positive and significant effect on the Adoption of Agricultural Electrification, while Farmer Trust had no significant effect. An R^2 value of 0.770 (77%) indicates that the model has strong explanatory power. This finding indicates that adoption decisions are more influenced by tangible benefits and ease of use than by trust. The implications of this research emphasize the importance of strengthening the dissemination of benefits and improving the ease of operation of the technology to accelerate agricultural electrification.

Keywords: Agricultural Electrification, Ease Of Use, Farmer Trust, Perceived Benefits

Introduction

The agricultural sector in Boyolali Regency remains heavily reliant on fossil fuels, particularly the use of diesel-powered water pumps to support irrigation (Rahman et al., 2025). This dependence burdens farmers due to frequent fuel price fluctuations during the planting season, increasing production costs each time prices rise (Weremczuk & Malitka, 2022). This situation contributes to agricultural instability, particularly as farmers lack alternative energy options that are more efficient, resilient to price fluctuations, and secure from fuel supply disruptions (Naman et al., 2025).

Advances in renewable energy technology present new opportunities for the agricultural sector through the implementation of more efficient and environmentally friendly electrification (Naman et al., 2025). Farmers are starting to switch from diesel pumps to electric pumps to reduce long-term operational costs and increase irrigation efficiency without reducing land productivity (Azİzoğlu & Koçyiğit, 2025). These developments highlight the importance of understanding farmers' perceptions of the

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benefits, ease of use, and trust in technology, as psychological factors influencing its acceptance (McCormack et al., 2022).

Farmers utilize diesel pumps to meet their irrigation needs, but they often feel that these devices do not provide optimal long-term benefits (Zulfikar et al., 2025). Diesel pumps have low fuel efficiency, forcing farmers to incur high costs even though irrigation yields are not commensurate with the fuel consumption (Oziel et al., 2024). This situation leads farmers to perceive diesel pumps as economically unprofitable, as operational costs exceed farming revenues (Rohtas et al., 2025).

Farmers also face various technical challenges that reduce the effectiveness of diesel pumps during the planting season (Abirami et al., 2023). This situation has prompted them to consider using new technologies, which are considered to offer greater benefits than fossil-fueled engines (Mahalakshmi, 2022).

Farmers face technical challenges when using diesel pumps because these machines require quite complex operational procedures (Saharuna et al., 2024). Starting the machine requires physical effort and technical expertise, often making it difficult for beginners (Lange et al., 2023). Before starting the pump, farmers need to check the condition of the oil, fuel, and engine components to ensure safe operation (Myalo et al., 2021). This procedure is time-consuming and disrupts the efficiency of the irrigation system when farmers need an immediate water supply (Diallo et al., 2024). Diesel engines are also difficult to start in humid weather or when fuel quality declines (Iovleva et al., 2022). This situation leads farmers to perceive diesel pumps as difficult to operate (Rozaq et al., 2022).

Farmers are beginning to experience a decline in confidence in diesel water pumps due to frequent sudden breakdowns during crucial irrigation periods (Suswandi et al., 2025). This damage results in a halt in water distribution, preventing plants from receiving an adequate supply during critical growth phases (Bijalwan et al., 2022). Furthermore, diesel engines are considered less reliable because their durability decreases with age (Ostrikov et al., 2024). This situation raises concerns that diesel pumps will not be able to consistently meet irrigation needs (Wardhana et al., 2023). This uncertainty encourages farmers to consider alternative irrigation technologies that are considered more stable (Jahangirpour & Zibaei, 2022).

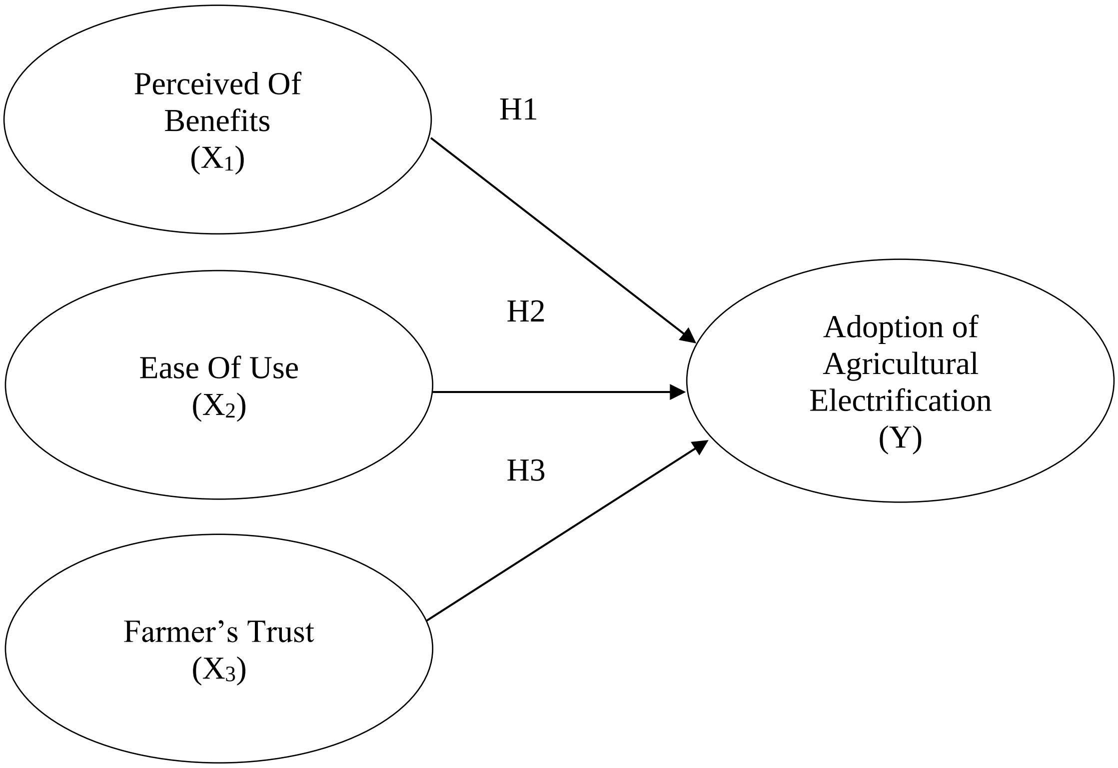
Although the Technology Acceptance Model (TAM) has been widely used to explain technology adoption in the agricultural sector, most previous research has focused on the use of digital applications and information services, rather than on the electrification of agricultural tools and machinery (Kumar & Devi, 2025). Modified TAM applications in the agricultural context have also not comprehensively incorporated the construct of trust as a key determinant of adoption behavior (Liu, 2022). Therefore, this study aims to address this gap by integrating the construct of trust into the TAM framework and conducting a more in-depth and systematic analysis of agricultural electrification (Sasmita et al., 2025).

This study aims to explain the influence of perceived benefits on farmers' decisions to adopt agricultural electrification technology as an alternative to diesel pumps, analyze the influence of perceived ease of use on farmers' intentions to switch from diesel-fueled pumps to electric-based water pumps, and identify the influence of farmers' level of trust in agricultural electrification technology in shaping their decisions during the adoption process.

Method

This study uses a quantitative descriptive method with an analytical approach to analyze the influence of Perceived Benefits (X1), Ease of Use (X2), and Farmer Trust (X3) on Agricultural Electrification (Y) on rice farmers in Giriroto Village, Ngemplak District, and Babadan Village, Sambi District, Boyolali Regency. The study was conducted from December 2025 to January 2026 with a population of all rice farmers who have used or have access to electric pumps, and the sample was determined through a non-probability sampling technique with a purposive method based on certain relevant criteria. Primary data were collected through a 1–5 Likert scale questionnaire, field observations, and limited interviews to strengthen the empirical context. Data analysis was carried out using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with the help of SmartPLS.

Figure1
SEM-PLS Structural Model



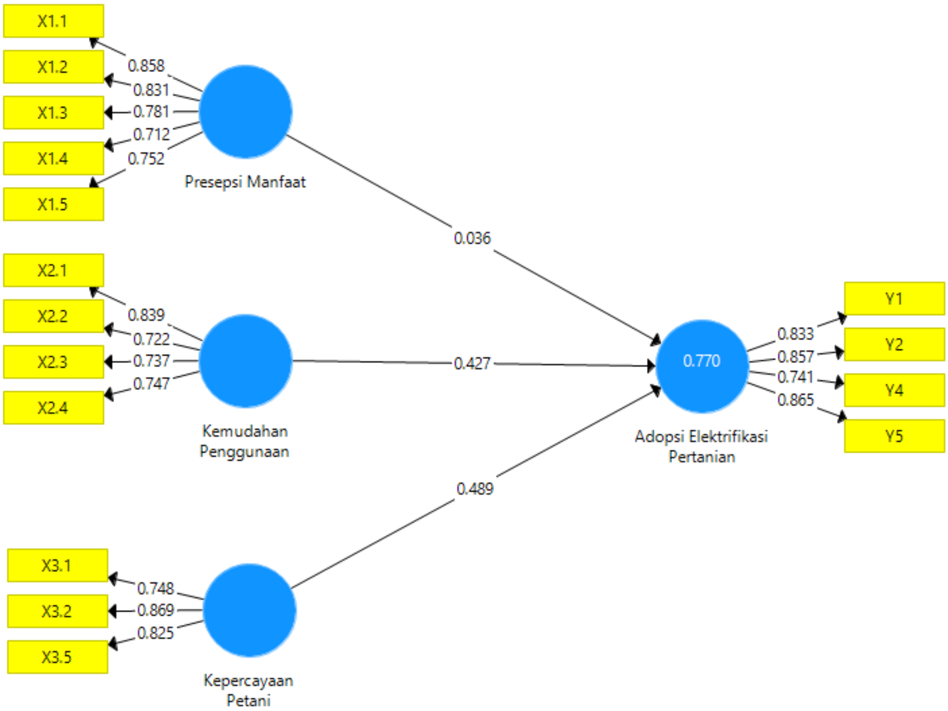
Source: Researcher Data (2026)

RESULT AND DISCUSSION

Path Diagram of Variable Relationships

A path diagram is a visual representation of the relationships between variables in a study. This diagram shows the direction of influence between latent variables through one-way arrows, making it easier for researchers to understand the model structure and the hypotheses being tested. In the diagram, latent variables are depicted as circles or ovals, while their indicators are represented by squares. The relationship between latent variables and indicators is called the measurement model (outer model), while the relationship between latent variables is called the structural model (inner model) (Fadhilah & Wachidah, 2023).

Figure 2
PLS Algorithm View After Evaluation



Source: Primary data processed in 2026

Based on Figure 2, all indicators meet the convergent validity criteria with outer loading values above 0.70. The variables Farmer Trust, Perceived Benefits, Ease of Use, and Adoption of Agricultural Electrification show adequate loading values, indicating that all indicators are valid and able to represent their constructs properly, so the research instrument is suitable for further analysis.

Inner Model and Outer Model

Inner model evaluation is an analysis stage that aims to assess the accuracy and robustness of the developed structural model. In the PLS approach, inner model testing begins with an analysis of the R-square value for each dependent latent variable to determine the extent to which the independent latent variables are able to explain variation in the dependent variable in the research model (Rahmaniah, 2020).

Meanwhile, the outer model evaluation is the analysis stage to ensure that the measurement instrument used meets the eligibility requirements, namely validity and reliability. The outer model assessment is based on three main criteria: convergent validity, discriminant validity, and composite reliability (Rafinda, 2025).

Table 1

Validity and Reliability of the Model

Variable	Indicator	Cross Loading				CA	rho_A	CR	AVE	R^2
		PM	KP	KEP	AEP					
Perceived of Benefit	PM_1	0,858	0,596	0,668	0,558	0,848	0,859	0,891	0,622	-
	PM_2	0,831	0,574	0,542	0,572					
	PM_3	0,781	0,372	0,585	0,444					
	PM_4	0,712	0,373	0,519	0,441					
	PM_5	0,752	0,430	0,387	0,453					
Ease of Use	KP_1	0,725	0,839	0,682	0,713	0,764	0,775	0,847	0,582	-
	KP_2	0,309	0,722	0,588	0,678					
	KP_3	0,448	0,737	0,501	0,522					
	KP_4	0,314	0,747	0,393	0,489					
Farmer Trust	KEP_1	0,748	0,537	0,748	0,562	0,748	0,762	0,856	0,665	-
	KEP_2	0,514	0,667	0,869	0,718					
	KEP_5	0,469	0,573	0,825	0,722					
Adoption of Agricutural Electrification	AEP_1	0,683	0,699	0,661	0,833	0,842	0,845	0,895	0,681	0,770
	AEP_2	0,626	0,617	0,691	0,857					
	AEP_4	0,281	0,652	0,635	0,741					
	AEP_5	0,482	0,688	0,732	0,865					

Source: Primary data processed in 2026

Perceived Benefit (X1) shows that all indicators have the highest cross-loading values on their own constructs (0.858; 0.831; 0.781; 0.712; 0.752) above 0.70, indicating discriminant validity, while Cronbach’s Alpha (0.848), rho_A (0.859), and Composite Reliability (0.891) ≥ 0.70 confirm reliability, and AVE (0.622) ≥ 0.50 indicates convergent validity. Theoretically, perceived benefit is a key construct in the Technology Acceptance Model (TAM) describing the belief that technology improves performance and productivity (Doss et al., 2024). In agriculture, farmers tend to adopt electrification technology when it is perceived to increase efficiency and reduce operational costs, consistent with Chaira et al., (2024) although differing from Feng & Zailani (2025). Field observations also indicate that farmers experience benefits such as reduced fuel costs and improved irrigation efficiency.

Ease of Use (X2) shows that all indicators have the highest cross-loading values on their own constructs (0.839; 0.722; 0.737; 0.747) above 0.70, indicating discriminant validity. Cronbach’s Alpha (0.764), rho_A (0.775), and Composite Reliability (0.847) ≥ 0.70 confirm good reliability, while AVE (0.582) ≥ 0.50 indicates convergent validity. Theoretically, in the Technology Acceptance Model (TAM), ease of use reflects the belief that technology is easy to understand and operate (Cozzi et al., 2025). In agriculture, this perception encourages farmers to adopt electrification technology, consistent with Sulistiyanto et al., (2025) although differing from Rana et al., (2025). Field observations also show that most farmers perceive the technology as relatively easy to use after receiving initial assistance.

Farmer Trust (X3) shows that all indicators have the highest cross-loading values on their own constructs (0.748; 0.869; 0.825) above 0.70, indicating discriminant validity. Cronbach’s Alpha (0.748), rho_A (0.762), and Composite Reliability (0.856) ≥ 0.70 confirm good reliability, while AVE (0.665) ≥ 0.50 indicates convergent validity. Theoretically, within the Technology Acceptance Model (TAM), farmer trust reflects the belief that electrification technology is safe and reliable (Yeo & Keske, 2024). This finding is consistent with Zhou et al., (2023), although it differs from Badriah et al., (2025). Field observations show that farmers begin to trust the technology after seeing its direct use, but adoption decisions are more influenced by perceived benefits and ease of use.

The Agricultural Electrification Adoption indicators show the highest cross-loading values on their own constructs (0.833; 0.857; 0.741; 0.865) above 0.70, indicating discriminant validity. Cronbach's Alpha (0.842), rho_A (0.845), and Composite Reliability (0.895) ≥ 0.70 confirm strong reliability, while AVE (0.681) ≥ 0.50 indicates convergent validity. The R^2 value of 0.770 shows that 77% of the variation in Agricultural Electrification Adoption is explained by the independent variables, while 23% is influenced by other factors.

Hypothesis Testing

Hypothesis testing in the Structural Equation Modeling–Partial Least Squares (SEM-PLS) method is an analysis stage aimed at determining whether exogenous latent variables significantly influence endogenous latent variables. This stage is carried out after the research model has been determined to meet the evaluation criteria for the outer and inner models (Nusrang et al., 2023).

Table 2

Hypothesis Testing

Path	Original Sample (O)	T Statistics	P Values	Sig	Conclusion
PM - AEP	0,427	3,627	0,000	Significant	Accepted
KP - AEP	0,489	2,906	0,004	Significant	Accepted
KEP - AEP	0,036	0,064	0,784	No Significant	Rejected

Source: Primary data processed in 2026

Description: T-ratio > 1.96 (a = 0.05)

Hypothesis 1 states that Perceived Benefits influence the Adoption of Agricultural Electrification. The analysis results indicate that Perceived Benefits (X1) have a positive and significant effect on the Adoption of Agricultural Electrification (Y), meaning the hypothesis is accepted. This shows that the higher the benefits perceived by farmers, the greater their tendency to adopt agricultural electrification technology. This influence is reflected in the indicators: (1) Reducing operational costs, (2) Increasing work efficiency, (3) Facilitating irrigation, (4) Increasing productivity, and (5) Providing long-term benefits, which illustrate that farmers consider both economic advantages and operational efficiency when deciding to adopt the technology.

Hypothesis 2 states that there is an influence of Ease of Use on the Adoption of Agricultural Electrification. The results of the analysis show that Ease of Use (X2) has a positive and significant effect on the Adoption of Agricultural Electrification (Y), so the second hypothesis is accepted. This indicates that the higher the level of ease perceived by farmers, the greater their tendency to adopt agricultural electrification technology. Operationally, Ease of Use becomes an important factor in technology adoption because it reflects farmers' belief that the technology can be easily understood and operated in farming activities. This influence is reflected in the indicators: (1) Technology is easy to learn, (2) Easy to operate, (3) Does not require special skills, (4) Use is not complicated, and (5) Maintenance is easy, which shows that ease of use includes simplicity in operation, procedures, and maintenance of the technology.

Hypothesis 3 states that there is an influence of Farmer Trust on the Adoption of Agricultural Electrification. The results of the analysis show that Farmer Trust (X3) does not have a significant effect on the Adoption of Agricultural Electrification (Y), so the third hypothesis is rejected. This indicates that although the relationship shows a positive direction, the level of trust held by farmers is not strong enough to significantly influence the adoption of agricultural electrification. Operationally, farmer trust reflects farmers' confidence in the safety, reliability, and performance of the technology. This influence is reflected in the indicators: (1) Safe to use, (2) Not easily damaged, (3) Increases agricultural yields, (4) Meets irrigation needs, and (5) Guaranteed quality, which indicate that trust relates to aspects of safety, durability, functionality, and technology quality.

The Influence of Perceived Benefits on the Adoption of Agricultural Electrification

Based on the results of the hypothesis test using the SEM-PLS method, Perceived Benefits (X1) were proven to have a positive and significant effect on the Adoption of Agricultural Electrification (Y) with a T-statistic value of 3.627 (> 1.96) and a path coefficient of 0.427, so the first hypothesis was accepted. These results indicate that the higher the perceived benefits felt by farmers, the greater their tendency to adopt agricultural electrification technology. This finding was obtained from research conducted in Giriroto Village, Ngemplak District, and Babadan Village, Sambi District, Boyolali Regency, Central Java, which were selected purposively. The results indicated that farmers tend to adopt agricultural electrification when they perceive tangible benefits, such as increased efficiency, operational ease, and potential increased productivity, so that perceived benefits become a key factor in driving the decision to adopt the technology. This finding is also in line with the research of Chaira et al., (2024) which stated that perceived benefits, such as energy efficiency and cost savings, influence farmers' decisions to adopt electric sprayers in horticultural farming.

The Influence of Ease of Use on the Adoption of Agricultural Electrification

Based on the results of the hypothesis test using the SEM-PLS method, Ease of Use (X2) was proven to have a positive and significant effect on the Adoption of Agricultural Electrification (Y) with a T-statistic value of 2.906 (> 1.96), a path coefficient of 0.489, and a P-value of 0.004 (< 0.05), so the second hypothesis was accepted. These results indicate that the higher the level of ease perceived by farmers in using technology, such as ease of operation and usage process, the greater their tendency to adopt agricultural electrification technology. This finding was obtained from research conducted in Giriroto Village, Ngemplak District, and Babadan Village, Sambi District, Boyolali Regency, Central Java, which were selected purposively. The results of the analysis indicate that farmers tend to adopt agricultural electrification technology when they feel it is easy to use, such as a simple operation process, easy system understanding, and uncomplicated installation, so that ease of use is an important factor in driving the decision to adopt the technology. This finding is in line with the research of Sulistiyanto et al., (2025) which shows that ease of use of devices is an important factor in encouraging the adoption of agricultural technology, because the easier the technology is to use and understand, the greater the tendency of farmers to adopt it.

The Influence of Farmer Trust on the Adoption of Agricultural Electrification

Based on the results of the hypothesis test using the SEM-PLS method, Farmer Trust (X3) shows a positive but insignificant influence on the Adoption of Agricultural Electrification (Y) with a T-statistic value of 0.064 (<1.96), a path coefficient of 0.036, and a P-value of 0.784 (>0.05), so the third hypothesis is rejected. These results indicate that the level of farmer trust is not strong enough to encourage the adoption of agricultural electrification technology. This finding was obtained from research conducted in Giriroto Village, Ngemplak District, and Babadan Village, Sambi District, Boyolali Regency, Central Java, which were selected purposively. The results of the analysis indicate that farmer trust is not a major factor in adoption decisions, because farmers tend to consider the direct benefits obtained and the ease of use of the technology. Farmer trust in this study includes the belief that the technology is safe to use, not easily damaged, able to increase agricultural yields, according to irrigation needs, and has guaranteed quality. Although some farmers consider the technology relatively safe and able to support the smooth operation of the irrigation system, these factors are not strong enough to influence adoption decisions. This finding contradicts research by Badriah et al. (2025), which found that user trust significantly influences technology adoption.

Conclusion

Based on the research results, Perceived Benefits and Ease of Use have a positive and significant effect on the Adoption of Agricultural Electrification, while Farmer Trust does not have a significant effect on the Adoption of Agricultural Electrification in Giriroto Village, Ngemplak District, and Babadan Village, Sambi District, Boyolali Regency. Efforts to increase the adoption of agricultural electrification need to be focused on strengthening the real benefits felt by farmers and increasing the ease of use of technology through training, mentoring, and simplification of operational systems. This research has limitations in the limited area coverage and the use of certain variables, so further research is recommended to expand the research location and add other variables that have the potential to influence technology adoption.

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