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(RESEARCH ARTICLE)

Effect of the quality of agricultural extension services on tobacco farmers satisfaction and the adoption of tobacco cultivation practices In Central Java

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Abstract

This study integrates the SERVQUAL approach, farmer satisfaction, and innovation adoption theory to explain how the quality of agricultural extension services influences the adoption of tobacco cultivation practices in Central Java. The study was conducted using a quantitative approach via a survey method. Data were collected from October to December 2025, involving 648 tobacco farmers from 28 districts in Central Java Province. Respondents were selected from farmer groups that received extension services and tobacco cultivation assistance from the Central Java Provincial Agriculture and Plantation Service. Primary data were obtained through questionnaires and interviews, while secondary data were derived from official documents related to the extension program. Subsequently, the data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test validity, reliability, relationships among latent variables, as well as direct and indirect effects within the research model. The results indicate that the adoption of tobacco cultivation is directly influenced by the reliability and empathy of extension workers, while physical evidence, responsiveness, and assurance do not have a direct effect. Through farmer satisfaction as a mediating variable, empathy, assurance, and responsiveness were found to have a significant effect on adoption, indicating that farmer satisfaction plays a crucial role in strengthening the acceptance and implementation of recommended cultivation practices.

Keywords: Quality of Extension Services; Reliability of Extension Workers; Empathy of Extension Workers; Farmer Satisfaction; Adoption of Tobacco Cultivation.

1. Introduction

In Indonesia, tobacco is a strategic agricultural commodity that plays a vital role in both the national and local economies. In addition to generating tax revenue for the government, tobacco is also a primary source of income for farming households in various production regions. This role positions tobacco not only as an economic commodity but also as an integral part of the rural socioeconomic system, particularly in production centers (Hariyanto et al., 2021).

Central Java Province is one of the main regions for tobacco cultivation, with a strong socioeconomic foundation. Areas such as Temanggung and Wonosobo have a long tradition of tobacco farming and produce distinctive-quality tobacco. Tobacco farming activities in this region drive rural economic dynamics through job creation, income circulation, and linkages with the processing and marketing sectors (Santosa et al., 2024). For farming households, tobacco is often the primary source of income, making the sustainability of its cultivation crucial to local economic conditions.

However, tobacco development in Central Java still faces various challenges. Industrial demand for raw materials exceeding local production points to opportunities for increased production but also indicates farmers' limited capacity to meet market standards (Central Java Provincial Department of Industry and Trade and Department of Agriculture and Plantation, 2023). Other challenges include price fluctuations, climate change affecting productivity, and limited

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adoption of efficient cultivation practices (Sahadewo et al., 2020; Istiyanti & Wicaksono, 2023). Data from 2024 show that tobacco production in Central Java remains concentrated in several key regencies, such as Temanggung, Rembang, Grobogan, Boyolali, and Wonosobo, with a fairly wide variation in productivity. This situation underscores that there is still significant potential for development, but it requires systematic capacity building for farmers.

In situations like this, enhancing farmers' capabilities is crucial for maintaining the sustainability and competitiveness of the tobacco farming industry (Arief et al., 2025) . These capabilities include technical cultivation skills and the ability to adapt to changes in the market and the environment. Strategic agricultural extension services help farmers implement good farming practices and share knowledge (Dwijatenaya et al., 2026). Various studies show that effective extension services can increase the adoption of innovations, improve crop quality, and enhance farmers' resilience to change (Rokhani et al., 2020; Arifin et al., 2023; Yanfika et al., 2024).

The quality of extension services is a key determinant of the success of this process. Beyond technical aspects, service quality also encompasses extension workers' ability to build trust, motivation, and interpersonal relationships with farmers. The SERVQUAL framework emphasizes five key dimensions: tangibles, reliability, responsiveness, assurance, and empathy. Research indicates that reliability and responsiveness play a crucial role in building farmers' trust, while empathy strengthens collaborative relationships and encourages the adoption of better farming practices (Ituriaga et al., 2024; Suranti & Yupianti, 2019; Keba & Kedir, 2020; Balasoundari et al., 2021).

Farmers' satisfaction with extension services reflects the quality of communication and the effectiveness of guidance. Satisfied farmers tend to be more trusting, more actively engaged, and more open to innovation, whereas dissatisfaction can lead to resistance and reduced participation. Previous studies have shown that responsive and needs-based communication can increase satisfaction while promoting the adoption of sustainable agricultural practices (Tambo & Matimelo, 2021; Rajkhowa & Qaim, 2021; Krishnan & Patnam, 2013; Buehren et al., 2019; Piñeiro et al., 2020; Li et al., 2022; Hill et al., 2013).

On the other hand, the rate of adoption of farming practices is a key indicator of the success of extension services. Adoption reflects not only initial acceptance but also the sustained implementation of innovations. Effective extension support has been shown to increase knowledge and drive sustainable behavioral change among farmers. Satisfaction with services further strengthens farmers' commitment to adopting innovations, while ineffective services can hinder the sustainability of farming operations.

Given these dynamics, this study examines three main aspects. First, the level of satisfaction among tobacco farmers regarding the quality of extension services they receive. Second, the influence of this satisfaction on farmers' decisions to adopt tobacco cultivation practices. Third, the relationship between the quality of extension services, farmer satisfaction, and the adoption rate of tobacco cultivation practices in Central Java. The results of this study are expected to contribute to research on satisfaction and the adoption of agricultural innovations. In practical terms, the research findings can also serve as input for the government in improving the quality of extension services and supporting the sustainability of the tobacco sector in Central Java.

2. Material and methods

This study was conducted in Central Java Province from October through December 2025 and involved tobacco farmers who were members of farmer groups receiving extension assistance. These locations were purposively selected based on the following criteria: (1) the farmer groups received assistance in tobacco cultivation from the Central Java Provincial Department of Agriculture and Plantations throughout 2025; (2) farmers received assistance from agricultural extension workers; and (3) farmers were located in tobacco-producing districts, including major centers and development areas.

This study employed a quantitative approach using interviews and surveys to obtain factual data on farmers' perceptions, experiences, and evaluations of extension services. This method was chosen because it can broadly describe population conditions and allow for the structured measurement of variables (Sugiyono, 2017).

A total of 648 people from 28 regencies in Central Java Province participated in this study. Temanggung Regency had the highest number of respondents (108), followed by Wonosobo (53), Boyolali (46), Pemalang (45), and Blora (42). Other regencies that contributed significantly were Magelang (36), Wonogiri (33), Tegal (32), Kendal (30), and Semarang (25). The number of respondents was relatively small and spread across various regencies, such as Karanganyar (23), Cilacap (19), Demak and Klaten (18 each), Pati and Grobogan (17 each), and Pekalongan and Purworejo (6 each). The number of respondents was even smaller in Sukoharjo (3) and Brebes and Kudus (1 each).

These differences stem from disparities in program implementation and the ease with which residents in each location could provide feedback. However, this selection ensured that respondents had direct experience with the program, so the data accurately reflects how the program is implemented across various types of agricultural areas.

The research data consists of primary and secondary data. Primary data was collected through questionnaires and interviews covering assessments of service quality, satisfaction levels, and adoption. In contrast, secondary data was sourced from official reports and documents related to the extension program.

This study employed a non-probability sampling technique combining purposive and convenience sampling to ensure the relevance of the respondents while capturing diverse field conditions. Although the distribution of respondents was uneven, the broad geographic coverage was deemed capable of providing a comprehensive empirical picture.

Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM). According to Hair *et al*. (2011), PLS-SEM is used to test the relationships among latent variables simultaneously by evaluating validity, reliability, and structural models, including the coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and significance tests via bootstrapping.

3. Results and discussion

3.1. *Outer Model* Analysis (Measurement Model)

Convergent validity was evaluated using two criteria: outer loadings and *Average Variance Extracted* (AVE). An indicator was deemed to meet convergent validity if it had *an outer* loading above 0.70, while a construct was deemed to have convergent validity if it had an AVE greater than 0.50.

Table 1 Validity Test Results

Indicator - Variable	***Outer loadings***
ADP_1 <- Tobacco Cultivation Adoption (Z)	0.803
ADP_2 <- Adoption of Tobacco Cultivation (Z)	0.819
ADP_3 <- Adoption of Tobacco Cultivation (Z)	0.727
AS_1 <- Assurance (X4)	0.868
AS_2 <- Assurance (X4)	0.865
AS_3 <- Assurance (X4)	0.868
EM_1 <- Empathy (X5)	0.817
EM_2 <- Empathy (X5)	0.832
EM_3 <- Empathy (X5)	0.759
RL_1 <- Reliability (X2)	0.859
RL_2 <- Reliability (X2)	0.855
RL_3 <- Reliability (X2)	0.843
RS_1 <- Responsiveness (X3)	0.811
RS_2 <- Responsiveness (X3)	0.865
RS_3 <- Responsiveness (X3)	0.885
SAT_1 <- Tobacco Farmers' Satisfaction (Y)	0.877
SAT_2 <- Tobacco Farmers' Satisfaction (Y)	0.862
SAT_3 <- Tobacco Farmers' Satisfaction (Y)	0.849
TG_1 <- Tangibles (X1)	0.747

TG_2 <- Tangibles (X1)	0.766
TG_3 <- Tangibles (X1)	0.843

Source: Data processing results, 2025.

Based on the results of data processing using SmartPLS, all indicators in the constructs of *Tangibles, Reliability, Responsiveness, Assurance, Empathy*, Farmer Satisfaction, and Cultivation Adoption showed *outer loading* values above 0.70. Thus, all indicators used in this study met the criteria for convergent validity and are suitable for retention in the model.

Table 2 *Average Variance Extracted* (AVE) Results

Variable	***Average Variance Extracted* (AVE)**
Assurance (X4)	0.752
Tobacco Cultivation Adoption (Z)	0.615
Empathy (X5)	0.645
Tobacco Farmers' Satisfaction (Y)	0.744
Reliability (X2)	0.726
Responsiveness (X3)	0.729
Tangibles (X1)	0.618

Source: Secondary data processed 2025.

Furthermore, the AVE calculations show that all constructs have values above 0.50, ranging from 0.615 to 0.752. This means that each construct explains more than half of the variance in its indicators. Based on these results, convergent validity has been established for all constructs.

3.2. Discriminant Validity Test

Discriminant validity is used to ensure that each construct in the model is clearly distinct and does not measure the same concept. In PLS-SEM-based research, this test is conducted using two approaches: the Fornell-Larcker criterion and the HTMT (Heterotrait-Monotrait Ratio).

3.2.1. a. Fornell–Larcker Criteria

The Fornell-Larcker criterion is used to compare the square root of the AVE with the correlation between constructs. A construct is considered to meet discriminant validity if the square root of the AVE is higher than its correlation with other constructs. These values can be seen in the diagonal section of the following table.

Table 3 Results of the *Fornell-Larcker* Criteria

Variable	***Assurance* (X4)**	**Adoption of Cultivation (Z)**	***Empathy* (X4)**	**Farmer Satisfaction (Y)**	***Reliability* (X2)**	***Responsiveness* (X3)**	***Tangibles* (X1)**
Assurance (X4)	0.867						
Adoption of Cultivation (Z)	0.522	0.784					
Empathy (X5)	0.719	0.565	0.803				
Farmer Satisfaction (Y)	0.756	0.570	0.802	0.863			

Reliability (X^2)	0.730	0.530	0.680	0.691	0.852		
Responsiveness (X3)	0.721	0.540	0.720	0.731	0.737	0.854	
Tangibles (X1)	0.564	0.422	0.560	0.585	0.631	0.631	0.786

Source: Secondary data processed 2025.

The results of the data analysis using SmartPLS indicate that all constructs met the Fornell-Larcker criteria for discriminant validity. This is evident from the root-mean-square AVE values for each construct, which are higher than their correlations with other constructs. The Tangibles construct has a root-mean-square AVE value of 0.786, which is higher than its correlation with Reliability (0.631). The Reliability construct also shows a value of 0.852, which is higher than its correlation with Responsiveness (0.737). Furthermore, Farmer Satisfaction has a value of 0.863, which is higher than its correlation with Assurance (0.756). Similarly, Cultivation Adoption has a value of 0.784, which is higher than its correlation with Farmer Satisfaction (0.756). Thus, each construct in the model is clearly distinct and does not overlap with the others. This means that the model meets the criteria for discriminant validity and is suitable for further analysis.

3.2.2. b. HTMT (Heterotrait-Monotrait Rasio)

Discriminant validity was also tested using the HTMT (Heterotrait-Monotrait Ratio) approach. In general, a construct is considered to meet discriminant validity if the HTMT value is below 0.90. For a more conservative criterion, a value below 0.85 is used.

The test results show that most construct pairs have HTMT values below 0.90. This means that, in general, the discriminant validity of the model has been met. However, there are still several construct pairs with values that are close to or slightly exceed the threshold, namely Assurance and Empathy at 0.922, Empathy and Farmer Satisfaction at 1.034, Responsiveness and Empathy at 0.935, and Farmer Satisfaction and Assurance at 0.907. Additionally, the Reliability–Empathy pair has a value of 0.885, which is still below 0.90 but quite close to that threshold.

Thus, although most constructs met the HTMT criteria, some relationships between constructs require further examination because they indicate a fairly strong conceptual proximity. Details of the HTMT values are presented in Table 4.

Table 4 HTMT (*Heterotrait-Monotrait Ratio*) Results

Variable	***Assurance* (X4)**	**Adoption of Cultivation Practices (Z)**	***Empathy* (X5)**	**Farmer Satisfaction (Y)**	***Reliability* (X2)**	***Responsiveness* (X3)**	***Tangibles* (X1)**
Assurance (X4)							
Adoption of Cultivation (Z)	0.673						
Empathy (X5)	0.922	0.789					
Farmer Satisfaction (Y)	0.907	0.746	1.034				
Reliability (X^2)	0.887	0.703	0.885	0.839			
Responsiveness (X3)	0.873	0.707	0.935	0.889	0.906		
Tangibles (X1)	0.733	0.593	0.781	0.765	0.820	0.836	

Source: Primary data, processed (2025)

High HTMT values indicate conceptual closeness among constructs, particularly within the dimensions of extension service quality such as empathy, assurance, and responsiveness. Theoretically, these dimensions are indeed interrelated, so strong relationships between constructs remain understandable. Thus, although some HTMT values are relatively high, these results are still acceptable as long as the Fornell-Larcker criteria are met and the indicators used remain consistent with the study's theoretical framework.

3.3. Construct Reliability Test

Construct reliability is used to assess the consistency of indicators in forming a construct. In PLS-SEM-based research, reliability testing is conducted using Cronbach's Alpha (CA) and Composite Reliability (CR).

In PLS-SEM, Composite Reliability is preferred because it accounts for the weights of each indicator. Therefore, CR is often considered more appropriate than Cronbach's Alpha. CA values in the range of 0.60–0.70 are still acceptable, particularly in social or exploratory research, as long as the CR values meet the required thresholds.

Thus, although some constructs have Cronbach's Alpha values slightly below 0.70, they can still be considered reliable because adequate Composite Reliability values support them. The results of the construct reliability test are presented in Table 5.

Table 5 *Data on Construct Reliability Test Results*

Variable	***Cronbach's alpha***	***Composite Reliability* (rho_a)**	***Composite Reliability* (rho_c)**
Assurance (X4)	0.835	0.836	0.901
Adoption of Aquaculture (Z)	0.689	0.701	0.827
Empathy (X5)	0.724	0.727	0.845
Farmer Satisfaction (Y)	0.828	0.828	0.897
Reliability (X^2)	0.812	0.814	0.888
Responsiveness (X3)	0.814	0.820	0.890
Tangibles (X1)	0.692	0.704	0.829

Source: Primary Data, processed (2025)

Based on the results of data analysis using SmartPLS, all constructs in this study have adequate reliability. This is evident from the Composite Reliability values, all of which are above the 0.70 threshold.

The Assurance construct (X4) has a Cronbach's Alpha value of 0.835 and a Composite Reliability of 0.901. The Farmer Satisfaction construct (Y) shows a Cronbach's Alpha value of 0.828 and a Composite Reliability of 0.897. Furthermore, the Reliability (X2) and Responsiveness (X3) constructs have Cronbach's Alpha values of 0.812 and 0.814, respectively, with Composite Reliability values of 0.888 and 0.890. The Empathy construct (X5) also met the reliability criteria with a Cronbach's Alpha value of 0.724 and a Composite Reliability of 0.845.

Meanwhile, the Cultivation Adoption (Z) and Tangibles (X1) constructs had Cronbach's Alpha values slightly below 0.70, at 0.689 and 0.692, respectively. However, both constructs are still considered reliable because their Composite Reliability values remain above 0.70—0.827 for Technology Adoption and 0.829 for Tangibles.

Thus, all constructs exhibit good internal consistency. The research instrument is deemed reliable and suitable for use in the structural equation modeling (SEM) phase, as well as for hypothesis testing.

3.3.1. Inner Model (Structural Model) Analysis

Table 6 *R-Square* (R^2) Values

Variable	R-Square	Adjusted R-Square
Tobacco Farming Adoption (*Farmers' Adoption*) (Z)	0.384	0.379
Tobacco Farmers' *Satisf*action (Y)	0.729	0.727

Source: Primary Data, processed (2025)

The coefficient of determination (R^2) for the Tobacco Cultivation Adoption variable is 0.384. This means that the exogenous constructs in the model account for 38.4% of the variation in tobacco cultivation adoption. Meanwhile, the remaining 61.6% is influenced by other factors outside the model that were not analyzed in this study. In the context of SEM, this value falls into the moderate category, indicating that the model is reasonably capable of explaining farmers' tobacco cultivation adoption behavior. For the "Tobacco Farmer Satisfaction" variable, the R^2 value is 0.729. This value indicates that the model has strong explanatory power, as the majority of the variation in farmer satisfaction can be explained by the variables within the model. However, 27.1% of the variation in satisfaction is still influenced by other factors, such as farmer characteristics, socioeconomic conditions, farming experience, and other external factors. Overall, the R^2 results show that the research model has good explanatory power, particularly in explaining tobacco farmers' satisfaction. Nevertheless, regarding cultivation adoption, there is still room for model development by adding other relevant variables in future research.

3.3.2. Effect Size (f^2)

Table 7 *Effect Size* (f^2) Test Results

No	Path	f^2
1	*Assurance* → Adoption of Aquaculture	0.001
2	*Assurance* → Adoption of Aquaculture	0.085
3	*Empathy* → Adoption of Aquaculture	0.018
4	*Empathy* → Farmer Satisfaction	0.265
5	Farmer Satisfaction → Adoption of Cultivation Practices	0.016
6	*Reliability* → Adoption of Cultivation Practices	0.011
7	*Reliability* → Farmer Satisfaction	0.004
8	*Responsiveness* → Adoption of Cultivation Practices	0.007
9	*Responsiveness* → Farmer Satisfaction	0.027
10	*Tangibles* → Adoption of Cultivation Practices	0.000
11	*Tangibles* → Farmer Satisfaction	0.009

Source: Primary Data, processed (2025)

Based on the effect size (f^2), the path from Empathy to Farmer Satisfaction contributes the most compared to other paths, with an f^2 value of 0.265. This value indicates that extension workers' empathy plays a significant role in shaping farmer satisfaction. Meanwhile, other exogenous paths show relatively small effects; some contribute almost nothing. However, these constructs are retained in the model because they still have a conceptual basis and are supported by theory. Thus, the contribution of each exogenous construct to the endogenous variable varies. In this model, extension workers' empathy is the most prominent factor in increasing farmer satisfaction.

3.3.3. Prediction of Relevance (Q^2)

Table 8 Predicted Relevance (Q^2) Values

Variable	SSO	SSE	Q^2 (=1−SSE/SSO)
Assurance (X4)	1.944.000	1.944.000	0.000
Adoption of Cultivation (Z)	1.944.000	1.509.799	0.223
Empathy (X5)	1.944.000	1.944.000	0.000
Farmer Satisfaction (Y)	1.944.000	905.600	0.534
Reliability (X^2)	1.944.000	1.944.000	0.000
Responsiveness (X3)	1.944.000	1.944.000	0.000
Tangibles (X1)	1.944.000	1.944.000	0.000

Source: Primary Data, processed (2025)

Assurance, Empathy, Reliability, Responsiveness, and Tangibles are exogenous constructs and therefore do not have Q^2 values. Q^2 values are calculated only for endogenous constructs, namely Tobacco Farming Adoption and Tobacco Farmer Satisfaction. The Q^2 value for Tobacco Farming Adoption, at 0.223, indicates that the model has fairly good predictive power regarding adoption behavior. Meanwhile, the Q^2 value for Tobacco Farmer Satisfaction, at 0.534, indicates a stronger predictive ability regarding farmer satisfaction. Overall, the Q^2 results show that the structural model has good predictive relevance. These findings are also consistent with the R^2 values discussed earlier.

3.3.4. Hypothesis Testing

Table 9 Results of Hypothesis Testing for the PLS-SEM Model

No	Hypothesis Code	Path of Influence	*t-statistic*	*p-value*	Decision
1	H1a	*Tangibles* → Farmer Satisfaction	2.163	0.031	Accepted
2	H1b	*Reliability* → Farmer Satisfaction	1.161	0.246	Rejected
3	H1c	*Responsiveness* → Farmer Satisfaction	3.206	0.001	Accepted
4	H1d	*Assurance* → Farmer Satisfaction	5,632	0.000	Accepted
5	H1e	*Empathy* → Farmer Satisfaction	9,009	0.000	Accepted
6	H2a	*Tangibles* → Adoption of Cultivation	0.359	0.720	Rejected
7	H2b	*Reliability* → Adoption of Cultivation	2.010	0.045	Accepted
8	H2c	*Responsiveness* → Adoption of Cultivation Practices	1.653	0.098	Rejected
9	H2d	*Assurance* → Adoption of Aquaculture	0.617	0.537	Rejected
10	H2e	*Empathy* → Adoption of Aquaculture	2,913	0.004	Accepted
11	H3	Farmer Satisfaction → Adoption of Cultivation Practices	2.646	0.008	Accepted

Source: Primary Data, processed (2025)

Farmer satisfaction is significantly influenced by the dimensions of tangibles, responsiveness, assurance, and empathy, while reliability does not show a significant influence. These findings indicate that farmer satisfaction is largely shaped by the quality of interactions between extension workers and farmers, trust in the extension workers' competence, and the personal attention provided during the extension process. In other words, farmer satisfaction in this context is more relational in nature and is not determined solely by the technical consistency of the service.

The results of this study are consistent with a number of studies in developing countries that indicate that farmer satisfaction is strongly influenced by perceptions of the quality of extension services, particularly in terms of interpersonal relationships and the competence of extension workers (Ganpat et al., 2014). Several previous studies have also emphasized the importance of service reliability and responsiveness in enhancing farmer satisfaction through consistent information and prompt Responses from extension workers (Danso-Abbeam et al., 2018). However, the results of this study indicate that this pattern does not fully apply in the context of tobacco cultivation.

The dimension of empathy emerges as the most dominant factor in shaping farmer satisfaction. Tobacco cultivation carries high production risks, is influenced by climate uncertainty, and is vulnerable to price fluctuations. Under these conditions, farmers tend to evaluate the quality of services based on the extension workers' ability to understand the real problems they face. Personal attention, a willingness to listen to complaints, and the ability to tailor recommendations to on-the-ground conditions are key aspects in shaping farmer satisfaction.

Meanwhile, the decision to adopt tobacco cultivation practices is influenced by more limited dimensions of service quality. The research findings indicate that only reliability and empathy have a significant effect on the adoption of these practices. Tangibles, responsiveness, and assurance, on the other hand, do not have a direct influence. These findings suggest that farmers are more likely to adopt cultivation practices when the information they receive is considered trustworthy and is conveyed through relationships built on closeness and mutual trust.

Farmer satisfaction has also been shown to have a significant impact on the adoption of tobacco cultivation practices. Farmers who are satisfied with extension services tend to have a higher level of trust in extension workers. This trust makes them more open to trying and implementing the recommended cultivation practices. Thus, satisfaction serves as a link between the quality of extension services and changes in farmers' behavior in the field. These findings support previous research that identifies satisfaction as a key factor in the adoption of agricultural innovations. Satisfaction can drive adoption by increasing trust, enhancing the perceived value of the information received, and strengthening the social learning process at the farmer community level (Shaba & Alam, 2024).

Overall, this study not only aligns with the existing literature but also places a stronger emphasis on the importance of empathy in agricultural extension. In the case of tobacco, the success of extension efforts is not determined solely by technical and procedural aspects. The quality of relationships, a humanistic approach, and the extension workers' ability to understand farmers' circumstances are key factors in building satisfaction and encouraging the adoption of cultivation practices.

3.3.5. Indirect Effects and the Mediating Role of Farmer Satisfaction

Table 10 Results of Specific Indirect Effects

Mediation Path	Coefficient	t-statistic	p-value	Notes
Reliability → Farmer Satisfaction → Adoption of Cultivation Practices	0.011	1.056	0.291	Not significant
Responsiveness → Farmer Satisfaction → Adoption of Cultivation Practices	0.029	1.978	0.048	Significant
Tangibles → Farmer Satisfaction → Adoption of Cultivation Practices	0.013	1.593	0.111	Not significant
Assurance → Farmer Satisfaction → Adoption of Cultivation Practices	0.049	2.327	0.020	Significant
Empathy → Farmer Satisfaction → Adoption of Cultivation Practices	0.083	2.546	0.011	Significant

ource: Primary Data, processed (2025)

The results of the specific indirect effects analysis indicate that Farmer Satisfaction acts as a partial mediator in the relationship between the quality of extension services and Tobacco Cultivation Adoption, but this does not apply to all service dimensions. The dimensions of empathy, assurance, and responsiveness were found to have significant indirect effects through farmer satisfaction, as indicated by t-statistic values > 1.96 and p-values < 0.05. These findings confirm that cultivation adoption is influenced not only directly by service quality but also by farmer satisfaction as a key mediator. Among the three dimensions, empathy exerts the greatest indirect influence; thus, an extension approach that understands farmers' needs, conditions, and personal characteristics is the most effective factor in building satisfaction and promoting adoption. Conversely, tangibles and reliability did not show a significant indirect effect because the t-statistic value was < 1.96 and the p-value was > 0.05. This indicates that physical resources and service reliability are indeed important, but not strong enough on their own to increase adoption through farmer satisfaction. Thus, farmer satisfaction acts as a more effective mediator for service dimensions that are interpersonal and psychosocial in nature, such as empathy, assurance, and responsiveness, compared to purely technical or physical aspects. These findings underscore the importance of extension services that are not only focused on technical information but also on building human connections, trust, personal attention, and service experiences that make farmers feel understood, valued, and confident in adopting recommended farming practices.

3.4. The Role Of Empathy in Agricultural Extension Services

Appropriate agricultural extension services play a crucial role in building strong relationships between extension workers and farmers. Farmers evaluate extension services not only based on the accuracy of technical information but also on the extension workers' ability to understand the conditions of their farming operations, resource constraints, and the risks they face. An empathetic approach makes farmers feel valued, heard, and more open to the guidance provided (Daxini et al., 2018; Takahashi et al., 2019). Empathy also strengthens farmers' trust because extension agents' recommendations are seen as more relevant to real-world needs in the field. The trust that grows from such interactions can increase farmers' acceptance of innovations and new farming practices (McCormack et al., 2021). Furthermore, empathy reduces the psychological distance between extension workers and farmers, making the extension process more dialogic, contextual, and less one-sided. Farmers are positioned as partners whose experiences are recognized in the learning process, rather than merely as recipients of information (Conteh et al., 2015). Thus, empathy is not merely a complement to the service but serves as a crucial foundation for building farmers' satisfaction, trust, and readiness to adopt changes in farming practices. These findings confirm that the success of agricultural extension is determined not only by resources, procedures, or the accuracy of technical material, but also by the quality of the human relationship between extension workers and farmers.

3.5. Consistency of Research Findings with Extension Conditions in the Field

The results of this study indicate that the quality of agricultural extension services plays a stronger role in shaping farmer satisfaction than in directly encouraging the adoption of tobacco cultivation practices. This finding aligns with on the ground realities, as most tobacco farmers already have extensive experience and relatively established cultivation practices. Therefore, the decision to adopt new practices is determined not only by the technical aspects of the service but also by farmers' experiences during their interactions with extension workers. The dominant role of empathy indicates that farmers value extension workers who can understand the conditions, limitations, and risks they face particularly those related to climate and market uncertainties. A humanistic, communicative, and participatory approach has proven more effective in building satisfaction than extension services that focus solely on delivering technical material. The finding that assurance and responsiveness influence satisfaction but not directly influence adoption suggests that extension agents' competence and responsiveness first foster farmers' trust and comfort before they consider implementing cultivation recommendations. Meanwhile, the direct influence of reliability on adoption underscores that the consistency and dependability of extension workers remain crucial, as farmers are more willing to adopt cultivation practices when extension workers are perceived as trustworthy and consistently present. However, the reliability of services alone is not sufficient to build satisfaction if it is not accompanied by a relational approach. Thus, tobacco extension cannot be understood merely as a process of technology transfer, but also as a process of social accompaniment that builds farmers' trust, satisfaction, and readiness to make decisions regarding the adoption of cultivation practices

4. Conclusion

The dimensions of agricultural extension service quality have varying effects on the satisfaction of tobacco farmers in Central Java. Farmer satisfaction was found to be significantly influenced by physical evidence, responsiveness, assurance, and empathy. Meanwhile, reliability did not show a significant effect. These findings indicate that farmer satisfaction is largely shaped by the quality of interactions, personal attention, and confidence in the extension workers' competence, rather than solely by the procedural delivery of services.

Tobacco cultivation adoption is directly influenced by reliability and empathy. Conversely, physical evidence, responsiveness, and assurance do not directly influence adoption. However, through farmer satisfaction as a mediating variable, empathy, assurance, and responsiveness were found to have a significant effect on adoption. Meanwhile, physical evidence and reliability did not show a significant indirect effect. These results indicate that service quality can influence adoption both directly and through farmer satisfaction, with empathy being the most consistently influential dimension.

Farmer satisfaction has a significant effect on the adoption of tobacco cultivation practices in Central Java. Farmers who are satisfied with extension services tend to be more open to accepting and implementing recommended cultivation practices. Thus, farmer satisfaction is a key factor in driving behavioral change and increasing the adoption of cultivation technologies at the farmer level.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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