

Enhancing Food Security through Tropical Wheat Development: The Relationship between Accessibility and Farmers' Perceptions with Adoption Readiness in Indonesia

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Abstract: Indonesia's increasing dependence on wheat imports highlights the urgency of developing tropical wheat cultivation to strengthen national food security. This study examines the relationship between accessibility to agricultural production facilities and infrastructure, farmers' perceptions of innovation, and their interest and readiness to adopt tropical wheat in Boyolali Regency. A quantitative approach was employed involving 90 farmers selected through disproportionate stratified random sampling. Data were collected through interviews and analyzed using descriptive statistics and Spearman rank correlation at a 5% significance level. The results indicate that accessibility and farmers' perceptions are both at moderate levels, as is farmers' readiness to adopt tropical wheat. Furthermore, accessibility ($\rho = 0.638$) and farmers' perceptions ($\rho = 0.672$) show positive and significant associations with adoption readiness. The findings highlight that cognitive evaluation plays a slightly more dominant role than structural access in shaping farmers' readiness. This study emphasizes that improving farmers' perceptions alongside strengthening access to agricultural resources is essential to accelerate the adoption of tropical wheat and reduce dependence on imports.

Keywords: Tropical Wheat, Accessibility, Farmers' Perception, Adoption Readiness, Food Security

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1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important food commodities with widely consumed derivative products in Indonesia. The domestic food processing industry relies heavily on wheat flour as a primary raw material for products such as instant noodles, bread, biscuits, and cereals [1]. Along with the rapid expansion of the food industry, wheat demand in Indonesia has steadily increased, positioning the country as one of the largest wheat importers in the world. However, this high level of consumption is not supported by sufficient domestic production, resulting in relatively weak national food security for this commodity. To date, most of Indonesia's wheat demand is fulfilled through imports from major producing countries [2]. Data on Indonesia's wheat imports during the period 2020–2024 are presented in Table 1.

Table 1. Wheat Imports in Indonesia, 2020–2024

Year	Wheat Imports (Million Tons)
2020	10.31
2021	11.49
2022	9.47
2023	10.89
2024	10.89

As shown in Table 1, Indonesia's wheat imports consistently range between 9 and 11 million tons annually, indicating a strong dependence on the global market [3]. This condition underscores the urgency of developing domestic wheat production as a strategic effort to enhance food security and reduce import dependency. Various initiatives have introduced tropical wheat cultivation through adaptive varieties such as

Nias, Timor, Selayar, Guri, and Dewata [4]. However, previous studies indicate that wheat productivity in tropical regions remains relatively low, averaging around 3.5 tons/ha, and reaching up to 5.8 tons/ha under more optimal agroclimatic conditions [5]. In Boyolali Regency, productivity has been reported to range from 0.71 to 2.34 tons/ha at an altitude of approximately 675 meters above sea level [6]. Furthermore, demonstration plots have been implemented since 2017 in Ngadirojo Village to introduce wheat cultivation practices and improve farmers' knowledge [7], highlighting both the potential and challenges of tropical wheat development at the farm level.

Despite these efforts, existing studies on wheat development in Indonesia have predominantly focused on agronomic and technical aspects, such as varietal suitability, productivity, and environmental conditions [8]. However, the adoption of new agricultural commodities is not solely determined by technical feasibility. It is also closely related to accessibility to production facilities and infrastructure, and farmers' perceptions of innovation. These factors are associated with farmers' interest and readiness to adopt tropical wheat cultivation. Nevertheless, studies that specifically examine the relationships between accessibility and farmers' perceptions with adoption readiness in the context of tropical wheat remain limited, indicating a significant research gap in the socio-economic dimension of wheat development.

Boyolali Regency, particularly the districts of Ampel, Mojosongo, and Boyolali, represents a strategic area to examine this issue due to its relatively suitable agroecological conditions and adequate infrastructure access. However, proximity to infrastructure and administrative centers does not necessarily reflect farmers' readiness to adopt new agricultural innovations. Farmers' decisions are closely associated with multiple factors, including perceptions of innovation, and the ease of accessing production facilities and infrastructure.

This study makes three key contributions to the literature on agricultural innovation adoption. First, it reconceptualizes adoption readiness not merely as an outcome variable, but as a pre-decisional state shaped by the interaction between structural accessibility and cognitive perception, thereby extending the Diffusion of Innovations framework beyond its conventional linear stage interpretation. Second, this study introduces a dual-structure mechanism, distinguishing between the "can adopt" dimension (driven by accessibility) and the "will adopt" dimension (driven by perception), offering a more nuanced explanation of why farmers may remain in a state of hesitant readiness despite favorable external conditions. Third, by situating these relationships within the context of tropical wheat development in Indonesia an underexplored commodity in socio-economic adoption studies this research provides context-specific empirical evidence that bridges the gap between technical feasibility and behavioral intention. Collectively, these contributions advance the understanding of how structural and cognitive factors jointly shape pre-adoption dynamics, moving beyond conventional descriptive approaches toward a more integrated explanatory framework.

This study is grounded in the Diffusion of Innovations Theory, which explains how individuals progress from knowledge to persuasion, decision, and implementation stages in adopting innovations. Within this framework, accessibility is positioned as an external facilitating condition that shapes the "can adopt" dimension, while farmers' perceptions represent the persuasion stage that drives the "will adopt" dimension of decision-making. Accordingly, adoption readiness is conceptualized as a pre-decisional state emerging from the interaction between structural feasibility and cognitive evaluation, providing a theoretical basis for the dual-structure mechanism proposed in this study.

2. METHOD

Time and Location of Research

The study was conducted in Boyolali Regency, Central Java, specifically in Sidomulyo and Ngarosari Villages in Ampel District, Butuh and Mojosongo Villages in Mojosongo District, and Siswodipuran and Banaran Villages in Boyolali District. Locations were selected using purposive sampling, based on criteria such as suitability of land and temperature for tropical wheat cultivation, predominance of rice farmers, and proximity to urban centers [9]. These areas were assumed to provide better access to agricultural facilities and infrastructure due to their relative closeness to the city center. Data collection was carried out over two months, from February to March 2026.

Method of Research

This study employed a quantitative approach to examine the relationship between accessibility to production facilities and farmers' perceptions of innovation with their interest and readiness for tropical wheat

cultivation. Primary data were collected using structured questionnaires and analyzed statistically to measure and quantify the relationships among variables [10].

Research Stages

The dependent variable in this study was farmers’ interest and readiness to adopt tropical wheat cultivation (Y), reflecting both psychological intention and practical preparedness to allocate resources. The independent variables included accessibility of agricultural production facilities and infrastructure (X₁), and farmers’ perceptions of innovation (X₂). Accessibility was measured through availability, affordability, and timeliness of inputs, and perception of innovation was assessed based on relative advantage, compatibility, and complexity.

The study employed a hypothetical model to examine the relationships between the independent variables and the dependent variable using Spearman Rank Correlation, appropriate for ordinal data [11]. The analysis aimed to identify the direction and strength of relationships between variables. The null hypothesis (H₀) stated that no significant relationship exists between the variables, while the alternative hypothesis (H₁) stated that significant relationships exist. This study contributes to the sustainable economy perspective by highlighting how improved accessibility and positive innovation perceptions may enhance farmers’ willingness to adopt alternative crops and support agricultural sustainability.

Conceptual Framework

This study proposes a conceptual framework in which accessibility of agricultural production facilities and infrastructure (X₁) and farmers’ perceptions of innovation (X₂) are statistically associated with farmers’ interest and readiness (Y). Accessibility is conceptualized as an external enabling condition, whereas perception reflects an internal cognitive dimension shaping how farmers interpret and evaluate the innovation. To clarify these analytical linkages, the framework is presented as follows:

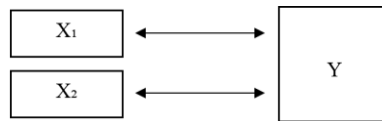


Figure 1. Conceptual Framework

Data Analysis

Instrument Test

Instrument quality was ensured through validity testing using Pearson Product Moment correlation and reliability assessment using Cronbach’s Alpha.

Descriptive Statistics

Descriptive statistics were employed to provide an overview of the distribution and relative levels of the key research variables, namely accessibility to agricultural production facilities and infrastructure, farmers’ perceptions of innovation, and farmers’ interest and readiness to adopt tropical wheat cultivation. This analysis serves as a preliminary step to identify general patterns and underlying conditions before examining the relationships between variables.

$$I = \frac{Max - Min}{n}$$

Where:

- I : Interval
- Max : Maximum Score
- Min : Minimum Score
- n : Number of Scores Categories

The categorization of variable scores for X₁ and X₂ was determined based on Table 2.

Score Range	Category
4,536 – 5,400	Very Good
3,672 – 4,536	Good
2,808 – 3,672	Moderate
1,944 – 2,808	Poor

1,080 – 1,944 Very Poor

Meanwhile, considering the variation in the number of measurement items, the classification of score levels for variable Y was determined based on Table 3.

Table 3. Score Interval Categories

Score Range	Category
4,158 – 4,950	Very Good
3,366 – 4,158	Good
2,574 – 3,366	Moderate
1,782 – 2,574	Poor
990 – 1,782	Very Poor

Spearman Rank Correlation

Spearman rank correlation was selected due to the ordinal nature of the data and its suitability for non-parametric analysis. This method is used to measure the direction and strength of the relationship between variables, as indicated by the correlation coefficient (ρ). A value of $\rho = 0$ indicates no correlation between variables, while $\rho = 1$ reflects a perfect positive correlation. A positive coefficient (+) signifies a direct relationship, meaning that as one variable increases, the other also tends to increase, whereas a negative coefficient (-) indicates an inverse relationship between the variables [12]. The interpretation of correlation strength in this study follows the classification presented in Table 4.

Table 4. Guidelines for Interpreting Correlation Coefficients

Coefficient Interval	Strength of Relationship
0.00 – 0.19	Very Weak Correlation
0.20 – 0.39	Weak Correlation
0.40 – 0.59	Moderate Correlation
0.60 – 0.79	Strong Correlation
0.80 – 1.00	Very Strong Correlation

Significance testing was conducted at a 5% level. The relationship was considered significant when the p-value < 0.05 and not significant when the p-value \geq 0.05.

3. RESULTS AND DISCUSSION

Research Location

Ampel, Mojosongo, and Boyolali sub-districts represent major agricultural areas in Boyolali Regency, each characterized by distinct topographical conditions. Ampel features relatively higher and more undulating terrain, whereas Mojosongo and Boyolali are predominantly flat to gently sloping. These geographical differences influence agricultural activities in the study area. The research location is presented in Figure 1.

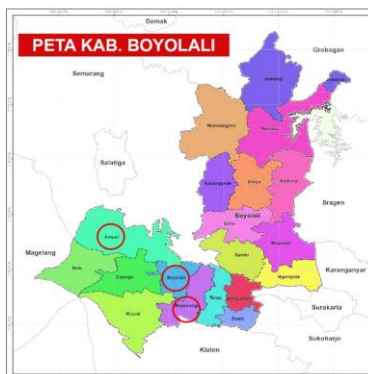


Figure 2. Research Location

The study area is predominantly composed of irrigated rice fields and dryland farming systems used for cultivating staple and secondary crops. Farming activities are largely influenced by water availability and seasonal patterns, with planting schedules following the local cropping calendar. These agroecological

conditions are important considerations for the potential development of tropical wheat, particularly in terms of planting time adjustment and water management within the existing farming system.

Respondent Characteristics

Demographic attributes, farming experience, and farmers’ economic conditions are closely associated with cognitive processes, decision-making, production capacity, financial capability, and the propensity to adopt agricultural innovations. The distribution of respondent characteristics is presented in Table 5.

Table 5. Farmers’ Age, Education Level, Farming Experience, and Landholding Size

Age	Number (Persons)	Education Level	Number (Persons)	Farming Experience (Years)	Number (Persons)	Landholding Size (ha)	Number (Persons)
≤ 42	7	No Formal Education	6	≤ 5	2	≤ 0.4	34
43 – 50	26	Primary School	34	6 – 15	48	0.5 – 0.9	40
51 – 58	32	Junior High School	26	16 – 25	28	1.0 – 1.4	8
59 – 66	18	Senior High School	20	26 – 35	11	1.5 – 1.9	4
≥ 67	7	Higher Education	4	≥ 36	1	≥ 2.0	4

Source: Primary Data Analysis (2026)

Most farmers were in the productive age group (43–66 years), indicating that respondents remain actively engaged in agricultural activities and are generally capable of considering new agricultural practices [13]. Their primary to secondary educational attainment suggests an adequate ability to access and comprehend farming-related information [14]. Moreover, with 6 to 25 years of farming experience, respondents demonstrate substantial practical knowledge in managing agricultural operations [15]. At the same time, landholding sizes ranging from ≤ 0.4 ha to 0.9 ha indicate that most respondents are smallholder farmers with limited production capacity [16]. Collectively, these characteristics are associated with their decision-making processes and their ability to assess agricultural innovations, including tropical wheat cultivation [17, 18].

Instrument Testing Results

All research instruments satisfied the required criteria for validity and reliability. The majority of questionnaire items exhibited correlation coefficients exceeding the critical threshold ($r > 0.207$), indicating that the measurement indicators were statistically valid [12]. Reliability testing, conducted using Cronbach’s Alpha, produced values above 0.60 for all variables, demonstrating acceptable levels of internal consistency [19]. These results confirm that the instruments used in this study are both valid and reliable, thereby ensuring the robustness of the data for subsequent statistical analysis.

Accessibility of Agricultural Production Facilities and Infrastructure

The extent to which farmers are able to access and utilize agricultural inputs and supporting facilities through aspects of physical and informational availability, affordability, and timeliness. The level of accessibility to agricultural production facilities and infrastructure is presented in Table 6.

Table 6. Level of Accessibility of Agricultural Production Facilities and Infrastructure

Indicator	Item	Score	Category
Information Access	Availability of Seed and Fertilizer Information	285	Moderate
	Sources of Production Input Information	297	Moderate
Physical Availability	Availability of Facilities and Infrastructure	334	Good
	Suitability of Facilities and Infrastructure	266	Moderate
Distance Affordability	Accessibility to Agricultural Input Kiosks	275	Moderate
	Distance to Input Providers	280	Moderate
Transportation Ease	Availability of Transportation	332	Good
	Road and Transportation Access	247	Moderate
Price Affordability	Production Cost Capability	300	Moderate
	Comparison of Production Costs	246	Moderate
Timeliness	Timeliness of Input Availability	257	Moderate
	Potential Availability of Production Inputs	265	Moderate
Total		3,384	Moderate

Source: Primary Data Analysis (2026)

The results presented in Table 6 show that the level of accessibility to agricultural production facilities and infrastructure in Boyolali reached a total score of 3,384, which falls within the interval of 2,808–3,672,

indicating a moderate category. This score represents the aggregate of all 12 statement items used to measure the accessibility variable.

A moderate level of accessibility reflects a condition in which production resources are available but not yet functioning optimally as enabling factors for innovation adoption. While farmers are generally able to access inputs, information, and infrastructure particularly in terms of physical availability and transportation this access remains uneven and situational. Constraints related to distance, affordability, and timeliness indicate that access is not consistently reliable across production cycles, which limits its effectiveness in supporting decision-making.

This condition likely stems from inefficiencies in input distribution systems and the limited financial capacity of smallholder farmers, which restrict their ability to secure inputs when needed. As a result, accessibility tends to reduce operational uncertainty rather than directly encourage adoption. In other words, access alone does not necessarily motivate farmers to adopt tropical wheat, but instead creates a minimum level of feasibility that allows them to consider it as an alternative. This interpretation extends previous findings by Nurkholipah et al. [20], which emphasize the importance of access to production resources and information in agricultural innovation adoption, by suggesting that its impact depends on how effectively it can be translated into actual use. Therefore, improving subsidies, input distribution efficiency, and delivery reliability is crucial not only to increase access, but also to enhance its functional role in supporting farmers’ readiness and reducing dependence on imported wheat.

Farmers’ Perceptions of Innovation

Farmers’ subjective assessment of the characteristics of tropical wheat as a new commodity, based on its relative advantage, compatibility with existing practices, and level of complexity. Farmers’ perceptions of tropical wheat cultivation innovation are presented in Table 7.

Table 7. Farmers’ Perceptions of Tropical Wheat Cultivation Innovation

Indicator	Item	Score	Category
Economic Value	Profit Potential	298	Moderate
	Financial Advantage	253	Moderate
Resource Efficiency	Resource Utilization	287	Moderate
	Input Requirements	249	Moderate
Technical Compatibility	Compatibility with Farming Experience	265	Moderate
	Similarity of Cultivation System	306	Good
Social Value Compatibility	Compatibility with Norms and Culture	356	Good
	Social Acceptance	288	Moderate
Technical Simplicity	Understanding of Cultivation Techniques	279	Moderate
	Availability of Technical Information	310	Good
Operational Simplicity	Use of Technology	285	Moderate
	Level of Cultivation Complexity	244	Moderate
Total		3,420	Moderate

Source: Primary Data Analysis (2026)

As shown in Table 7, farmers’ perceptions of tropical wheat cultivation innovation in Boyolali achieved a total score of 3,420, which falls within the interval of 2,808–3,672, indicating a moderate category. This total score represents the aggregate of all 12 statement items used to measure the variable of farmers’ perceptions toward innovation.

Farmers’ perceptions of tropical wheat cultivation indicate a transitional evaluation stage, where the innovation is neither fully accepted nor rejected. Although farmers recognize its potential as an alternative commodity, their assessment remains cautious, particularly regarding profitability, resource efficiency, and practical applicability. This suggests that perception is still shaped by uncertainty rather than strong conviction, limiting its ability to fully drive adoption readiness.

Such a moderate perception can be explained by the limited availability of experiential evidence at the farm level. Without consistent exposure to successful cultivation outcomes, farmers rely on partial information and subjective judgment, which tends to produce balanced but hesitant evaluations. In this context, perception functions as a cognitive filter that determines how farmers interpret both opportunities and risks associated with tropical wheat. This explains why, despite the presence of supporting infrastructure, adoption does not automatically occur. The finding is consistent with Imani et al. [21], who observed that farmers’ acceptance of new technologies tends to remain moderate during early introduction stages, particularly when access to information and extension support is still limited. Consequently, strengthening perception requires more than

information dissemination; it requires demonstrable results through field trials and extension activities that can transform abstract knowledge into practical confidence [22].

Farmers’ Interest and Readiness for Tropical Wheat Cultivation

The psychological and factual conditions reflecting farmers’ internal motivation and their willingness to allocate resources toward the adoption of tropical wheat. Farmers’ Interest and Readiness for Tropical Wheat Cultivation are presented in Table 8.

Table 8. Farmers’ Interest and Readiness for Tropical Wheat Cultivation

Indicator	Item	Score	Category
Willingness to Try	Interest in Trying	323	Good
	Market Information Seeking	229	Poor
Resource Commitment	Participation in Extension Activities	318	Good
	Land and Capital Allocation Planning	205	Poor
	Readiness to Allocate Land and Capital	327	Good
	Labor Readiness	180	Poor
Priority Scale	Consideration of Labor Allocation	341	Good
	Willingness to Allocate Partial Land	279	Moderate
	Willingness to Allocate All Land	181	Poor
	Willingness to Allocate Remaining Land	324	Good
Risk Willingness	Interest under Uncertainty	203	Moderate
	Total	2,910	Moderate

Source: Primary Data Analysis (2026)

Referring to Table 8, farmers’ interest and readiness for tropical wheat cultivation in Boyolali achieved a total score of 2,910, which falls within the interval of 2,574–3,366, indicating a moderate category. This score represents the aggregate of all 11 statement items used to measure the variable of interest and readiness for tropical wheat cultivation.

The moderate level of farmers’ interest and readiness suggests that farmers are positioned in a pre-adoption phase, where curiosity and initial consideration are present but not yet followed by firm commitment. This is reflected in the discrepancy between farmers’ willingness to seek information and their reluctance to allocate key resources such as land, capital, and labor. Such a pattern indicates that readiness is constrained not by a lack of awareness, but by the perceived risks associated with implementation.

This hesitation is likely driven by economic uncertainty and resource limitations typical of smallholder farming systems. Farmers tend to prioritize stability and minimize risk, especially when adopting a new commodity with uncertain returns. As a result, even when interest exists, readiness remains conditional upon stronger guarantees of profitability and feasibility. This finding reinforces the argument that interest alone is insufficient to drive adoption, as readiness requires both motivation and capacity. In line with Diffusion of Innovations Theory, this condition reflects the transition between the persuasion and decision stages, where farmers critically evaluate the innovation before committing to adoption [23]. Supporting this, Agussabti et al. [24] highlight that readiness is significantly associated with farmers’ willingness to adjust farming practices and allocate resources, in relation to perceived economic benefits. Therefore, strengthening market assurance, profitability evidence, and institutional support becomes essential to convert initial interest into actual adoption and promote sustainable agricultural transformation.

Spearman Rank Correlation Analysis

Spearman’s rank correlation was used to examine the relationships among the research variables. This analysis yielded a correlation coefficient (ρ) indicating the direction and strength of the relationships between variables, as well as a significance value (Sig. 2-tailed) used to test the research hypotheses at a significance level (α) of 0.05. Table 9 presents the results of Spearman’s Rank Correlation Test.

Table 9. Results of Spearman’s Rank Correlation Test

Variables	Correlation Coefficient (ρ)	Sig. (2-tailed)	n	Interpretation
Accessibility of Agricultural Production Facilities and Infrastructure (X_1) ↔ Interest and Readiness for Tropical Wheat Cultivation (Y)	0.638**	0.000	90	Strong and Significant
Farmers’ Perceptions of Innovation (X_2) ↔ Interest and Readiness for Tropical Wheat Cultivation (Y)	0.672**	0.000	90	Strong and Significant

** . Correlation is significant at the 0.01 level (2-tailed).

Source: Author’s analysis using Correlate in IBM SPSS Statistics 27 (2026)

Table 9 indicates that accessibility of production facilities and infrastructure ($\rho = 0.638$) and farmers' perceptions of innovation ($\rho = 0.672$) are both positively and significantly associated with farmers' interest and readiness ($p < 0.05$). These coefficients reflect not only the presence of relationships but also their relative strength, suggesting that both structural and cognitive factors play important roles in shaping pre-adoption conditions.

The positive relationship between accessibility and farmers' readiness indicates that access functions not as a direct driver of adoption, but as a conditional enabler that shapes the feasibility boundary of decision-making. Rather than actively motivating farmers, accessibility reduces operational uncertainty by ensuring that inputs, information, and infrastructure are within reach. However, its effect remains contingent upon the consistency and reliability of access, particularly in terms of affordability and timeliness. This suggests that accessibility operates through a risk-reduction mechanism, where improved access lowers perceived implementation barriers but does not eliminate uncertainty regarding outcomes. As a result, farmers may reach a state of "feasible consideration" without transitioning into actual commitment, explaining why moderate accessibility does not automatically lead to high readiness despite the presence of supporting infrastructure. This interpretation aligns with previous findings that position accessibility as a key component of farmers' adaptive capacity, while emphasizing its dependence on reliable and usable resource access [20], [25].

From a theoretical perspective, within the framework of Diffusion of Innovations Theory, these findings indicate a stronger association between structural factors and the "can adopt" dimension compared to the "will adopt" decision. Accessibility, therefore, defines the opportunity space without necessarily determining behavioral intention. This extends prior studies by highlighting that the effectiveness of access depends not only on its availability, but also on its ability to stabilize production expectations across cycles [20].

Farmers' perceptions of innovation exhibit a slightly stronger relationship with readiness, highlighting the central role of cognitive evaluation in shaping behavioral intention. Unlike accessibility, which operates externally, perception functions as an internal decision filter through which farmers interpret the potential benefits, risks, and compatibility of tropical wheat cultivation. The dominance of perception suggests that adoption readiness is primarily driven by how farmers construct meaning around the innovation rather than by the mere presence of supporting resources. In conditions of limited experiential evidence, farmers rely on subjective judgment, resulting in cautious yet balanced evaluations. Consequently, innovation may be recognized as promising but not sufficiently convincing to justify resource commitment, a pattern consistent with studies showing that farmers' perceptions tend to remain moderate during early stages of innovation exposure [21], [22].

Mechanistically, perception is related to readiness through a belief-formation pathway, where perceived profitability, complexity, and compatibility interact to shape confidence in expected outcomes. When these perceptions remain moderate, they generate hesitant readiness characterized by interest without commitment explaining the gap between farmers' willingness to seek information and their reluctance to allocate land, capital, and labor, as also highlighted in prior studies on economic considerations in adoption decisions [24]. Within the framework of Diffusion of Innovations Theory, this finding reinforces the importance of the persuasion stage, while extending it by showing that in smallholder contexts, this stage can become a bottleneck that delays progression to decision and implementation phases [23]. Therefore, strengthening perception requires not only information dissemination but also experiential validation through demonstrable and economically viable outcomes [21].

The combined results indicate that accessibility and perception do not operate independently, but interact in shaping adoption readiness through a dual-structure mechanism, where accessibility reduces external constraints while perception determines internal motivation. The absence of either factor limits the effectiveness of the other: improved accessibility without positive perception leads to underutilized resources, whereas positive perception without adequate access constrains implementation, preventing intention from translating into action. This explains why both variables show strong yet partial associations when examined individually. Accordingly, this study proposes that adoption readiness emerges from the alignment between structural feasibility and cognitive conviction; when both dimensions are sufficiently strong, readiness shifts from conditional to actionable, but when either remains moderate, farmers tend to remain in a pre-adoption equilibrium characterized by cautious interest and delayed commitment.

4. CONCLUSION

Farmers in Boyolali exhibit intermediate levels of accessibility to production facilities (score: 3,384) and moderately positive perceptions of tropical wheat cultivation (score: 3,420), indicating initial recognition alongside persistent concerns regarding profitability and feasibility. Their interest and readiness to adopt tropical wheat are also at a moderate level (score: 2,910), reflecting cautious consideration rather than immediate commitment. Spearman rank correlation analysis shows that farmers' perceptions ($\rho = 0.672$) and accessibility ($\rho = 0.638$) are positively and significantly associated with adoption readiness. These findings indicate that cognitive evaluation plays a more decisive role than structural access in shaping pre-adoption behavior. Strengthening farmers' perceptions through demonstrable outcomes, alongside improving access to inputs and infrastructure, is essential to transform initial interest into actual adoption. Future research should incorporate institutional and market dimensions to provide a more comprehensive understanding of agricultural innovation adoption.

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