

Innovation Characteristics Incorporating Local Wisdom and Their Influence on the Adoption Level of Corn Conservation Farming

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ABSTRACT

Sustainable agricultural innovations, such as conservation-based corn farming, continue to face major challenges related to low levels of adoption among smallholder farmers. One of the main causes is the lack of harmony between newly introduced technologies and the existing local wisdom, cultural values, and farming traditions that shape farmers' decision-making behavior. This study aims to analyze the influence of innovation characteristics, relative advantage, compatibility, complexity, trialability, and observability when integrated with local wisdom on the adoption level of corn conservation farming. The research employed a mixed-methods approach in Bengkilu Village, West Kalimantan, combining quantitative data collected from 100 farmers with qualitative data from in-depth interviews and field observations. Data were analyzed using Structural Equation Modeling (SEM) to identify the strength of relationships among variables. The results provide empirical insight into how the alignment between innovation attributes and local wisdom enhances farmers' willingness to adopt sustainable technologies. The findings are expected to contribute to agricultural policy formulation and the design of locally adapted innovation dissemination strategies to promote sustainable corn cultivation in rural communities.

INTRODUCTION

The growing global demand for sustainable and environmentally responsible agricultural practices has become increasingly urgent, reflecting concerns about land degradation, biodiversity loss, and the long-term stability of food production systems (FAO, 2017). Environmental degradation not only threatens agricultural productivity but also endangers the ecological balance that sustains rural livelihoods. In response to these challenges, conservation agriculture has emerged as a key strategy emphasizing soil preservation, efficient land management, and regenerative production systems that enhance both environmental and economic sustainability (Wahyudi & Wulandari, 2019).

In Indonesia, efforts to promote conservation-based corn farming have been intensified as part of national strategies to increase productivity while reducing erosion and maintaining soil fertility (Nasir et al., 2019). However, the adoption rate of these innovations among farmers remains relatively low, particularly in rural areas where traditional agricultural systems are deeply rooted. This situation reveals a significant gap between top-down technological innovations and the local socio-cultural context in which farmers operate (Darwis, 2020). Farmers who have long relied on inherited traditional knowledge often perceive new agricultural technologies as uncertain, risky, or incompatible with established practices (Erna Mena Niman, 2019). Consequently, adoption decisions are not merely technical but are shaped by social norms, values, and local wisdom that influence how farmers evaluate new practices (Pesurnay, 2018; Runtiko et al., 2019).

From a theoretical standpoint, Rogers' Diffusion of Innovations Theory (1995) identifies five perceived innovation characteristics (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability as key determinants of adoption behavior. These attributes explain why some innovations diffuse rapidly while others fail to gain traction. However, subsequent studies have shown that such models often overlook the socio-cultural dimension that shapes local adaptation and perception processes (Wahyuni et al., 2019; Setiawan et al., 2021). Integrating local wisdom into the innovation adoption framework is thus essential to ensure contextual relevance and social acceptance.

Empirical evidence from Indonesia supports this view. For example, Astuti et al. (2019) found that farmers' perceptions of innovation characteristics strongly influenced their willingness to adopt the Jajar Legowo rice planting system, while Sirajuddin (2021) observed that social and cultural factors were decisive in the adoption of the same innovation in Gorontalo. Similarly, Iskandar and Nurtilawati (2019) emphasized that the success of agricultural innovation dissemination depends not only on technological performance but also on farmers' trust and cultural alignment with traditional values. These findings align with studies such as Destiani and Saridewi (2021), which highlight that farmers' perception and experience shape the practical adoption of land conservation technologies. At the same time, mixed-method approaches in agricultural research have proven valuable for analyzing both the quantitative patterns and the qualitative meanings behind adoption behavior

(Creswell, 2015; McKim, 2017). By employing Structural Equation Modeling (SEM), complex relationships between innovation attributes and socio-cultural variables can be visualized and measured effectively (Epskamp, 2015). In the context of West Kalimantan, where local wisdom forms the foundation of rural livelihoods, integrating such approaches offers an opportunity to reveal how innovation characteristics interact with indigenous knowledge systems to influence adoption outcomes.

This study aims to fill the existing research gap by examining the influence of innovation characteristics integrated with local wisdom on the adoption of corn conservation farming in Bengkilu Village, West Kalimantan. Specifically, it investigates how Rogers' five innovation attributes, when contextualized within local socio-cultural frameworks, collectively shape farmers' adoption decisions. The study hypothesizes that innovations aligned with traditional norms, local ecological knowledge, and cultural practices foster greater acceptance, trust, and long-term sustainability among farming communities. Through this perspective, the research contributes to a more context-sensitive model of agricultural innovation adoption, supporting Indonesia's transition toward sustainable and inclusive agricultural development.

LITERATURE REVIEW

While agricultural innovation has long been recognized as a key driver of productivity and sustainability, the adoption of such innovations among smallholder farmers in Indonesia remains uneven. Numerous studies have explored the factors influencing innovation diffusion in agriculture, including economic incentives, extension services, and technological accessibility (Astuti et al., 2019; Wahyudi & Wulandari, 2019). However, relatively little attention has been paid to how local wisdom (*kearifan lokal*) interacts with innovation characteristics to shape farmers' adoption behavior – particularly in the context of conservation-based corn farming systems.

Existing literature tends to emphasize the technological or economic dimensions of agricultural innovation, often overlooking the cultural and ecological contexts that determine its sustainability. Wahyuni et al. (2019) and Setiawan et al. (2021) argue that successful innovation in rural communities depends not only on the intrinsic qualities of the technology – such as its relative advantage, compatibility, complexity, trialability, and observability – but also on its alignment with local customs, values, and environmental practices. In traditional farming communities, innovations that disregard local wisdom are frequently met with resistance or superficial adoption, as they disrupt established socio-ecological balances (Pesurnay, 2018).

In Indonesia's rural agricultural systems, local wisdom functions as an adaptive cultural framework that regulates farmers' interaction with nature, resource management, and collective decision-making. Erna Mena Niman (2019) explains that "local wisdom" acts as a repository of ecological intelligence, guiding sustainable land use practices through community-based norms. For instance, soil conservation techniques, crop rotation, and organic

fertilizer use have long existed within indigenous farming systems—yet they are often reintroduced as “modern innovations” without acknowledging their cultural roots. This underscores the importance of integrating scientific innovation with locally embedded knowledge systems to ensure long-term acceptance and relevance (Darwis, 2020).

Although several studies, such as those by Runtiko et al. (2019) and Nasir et al. (2019), have demonstrated that innovation adoption is more successful when aligned with socio-cultural realities, most of these works focus on specific commodities like tobacco or rice. Empirical investigations on the adoption of conservation innovations in corn farming remain limited, despite corn’s strategic importance as both a staple and a cash crop in Indonesia’s dryland ecosystems. Moreover, studies tend to isolate technological factors from the social dynamics that mediate adoption, such as peer influence, collective learning, and farmer group participation (Sirajuddin, 2021; Destiani & Saridewi, 2021).

The limited number of studies addressing the interaction between innovation characteristics and local wisdom creates a significant research gap. There remains insufficient understanding of how farmers evaluate innovations not only in terms of efficiency and yield improvement but also their compatibility with traditional ecological practices, cultural norms, and risk perceptions. Adiyanta (2019) and Soesanto (2022) emphasize that context-specific innovation models that integrate social systems, values, and institutional governance are essential for achieving sustainable adoption in rural communities.

This study, therefore, seeks to bridge this gap by analyzing how the characteristics of innovation, particularly those integrated with local wisdom, influence the adoption level of corn conservation farming innovations. It aims to identify which innovation attributes are most influential in shaping adoption behavior, while highlighting the mediating role of cultural adaptation, environmental awareness, and collective learning mechanisms. By combining empirical analysis with socio-cultural interpretation, this research contributes to a deeper theoretical and practical understanding of community-based agricultural innovation systems.

The findings are expected to enrich the discourse on sustainable agricultural transformation in Indonesia by demonstrating that local wisdom is not an obstacle but a catalyst for innovation diffusion. Furthermore, the study provides valuable insights for policymakers, extension agents, and development practitioners to design participatory and culturally grounded agricultural innovation programs that promote both ecological conservation and rural economic resilience.

METHODOLOGY

Research Design

This study adopts a mixed-methods research design, integrating quantitative and qualitative approaches to obtain a comprehensive understanding of how local wisdom influences the adoption of innovation in sustainable maize farming systems. The quantitative component measures the

relationships among innovation characteristics, local wisdom, and innovation adoption levels, while the qualitative component explores farmers' perceptions, cultural practices, and contextual meanings surrounding conservation-based maize farming. The integration of both strands strengthens analytical depth, ensuring that statistical findings are supported by field-based narratives and lived experiences.

Study Area and Sampling

The research is conducted in Dusun Laek, Desa Bengkilu, Kecamatan Tujuh Belas, Kabupaten Bengkayang, West Kalimantan. This area was purposively selected because it represents one of the key agricultural communities that has entered a conservation agreement with Yayasan Planet Indonesia, actively implementing sustainable maize farming practices.

A total of 100 farmers engaged in conservation-based maize cultivation are selected using purposive sampling, ensuring participants possess direct experience with innovation adoption. The sample reflects diverse socio-economic and demographic characteristics, including farm size, age, education, and farming experience.

Data Collection

1. Quantitative Survey

Quantitative data are collected through a structured questionnaire designed to assess the variable "Innovation Characteristics" (X) based on Rogers' (1995) Diffusion of Innovations Theory, which comprises five key dimensions:

- a. **Relative Advantage:** The perceived economic or technical benefits of the innovation compared with previous traditional practices.
- b. **Compatibility:** The degree to which the innovation aligns with local values, needs, and traditional knowledge systems.
- c. **Complexity:** The extent to which farmers perceive the innovation as easy or difficult to understand and implement.
- d. **Trialability:** The opportunity for farmers to test the innovation on a limited scale before full adoption.
- e. **Observability:** The visibility of innovation results and benefits within the community.

The questionnaire also includes items measuring the level of innovation adoption and the role of local wisdom in moderating innovation decisions. Respondents indicate their level of agreement using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). To ensure the instrument's validity and reliability, a pilot test is conducted, and internal consistency is evaluated using Cronbach's Alpha.

2. Qualitative Interviews

Complementing the quantitative survey, in-depth interviews are conducted with selected farmers, local leaders, and program managers from Yayasan Planet Indonesia. These interviews capture local interpretations of

innovation, the cultural logic underlying conservation practices, and barriers or motivations toward adoption.

Additionally, field observations are performed to document farming practices, land-use patterns, and farmer interactions during the innovation process. All qualitative data are audio-recorded, transcribed, and coded for analysis.

Data Analysis

1. Quantitative Analysis

Quantitative data are analyzed using Structural Equation Modeling (SEM) to examine direct and indirect relationships among the latent variables – innovation characteristics, local wisdom, and innovation adoption level. Descriptive statistics summarize demographic profiles, while inferential analyses test the structural model fit and hypothesis relationships using AMOS or SmartPLS software.

2. Qualitative Analysis

Qualitative data are processed using thematic analysis, involving coding, categorization, and theme development to identify recurring patterns related to cultural adaptation, farmer learning processes, and local wisdom integration. The analysis follows a systematic procedure of data familiarization, open coding, and thematic synthesis.

3. Integration of Findings

Findings from both quantitative and qualitative analyses were integrated to provide a holistic interpretation of how innovation characteristics embedded with local wisdom influence farmers' adoption behavior in conservation-based maize farming. Quantitative results provided measurable relationships among variables, while qualitative insights enriched the interpretation by revealing the social and cultural context through which these innovations were adopted and sustained within the community.

Table 1. Demographic Characteristics of Respondents (n = 100)

Variable	Frequency (n)	Percentage (%)
Gender: Male	58	58.0
Gender: Female	42	42.0
Age: 20–35 years	23	23.0
Age: 36–50 years	62	62.0
Age: 51–60 years	15	15.0
Education: Elementary School	36	36.0
Education: Junior High School	23	23.0
Education: Senior High School	15	15.0
Education: University	1	1.0
Education: Never Went to School	25	25.0
Farming Experience: 4–10 years	54	54.0
Farming Experience: 11–17 years	25	25.0
Farming Experience: 18–25 years	21	21.0

Table 1 presents the demographic distribution of the 100 maize farmers surveyed in Dusun Laek, Bengkilu Village. The majority of respondents (62%)

are within the productive age group of 36–50 years, indicating an active farming population capable of adapting to innovation. Males dominate agricultural decision-making (58%), reflecting a traditional gender role in rural farming systems, while women (42%) remain significantly involved in supporting on-farm and household agricultural activities. Educational levels are relatively low, with 36% completing elementary school and 25% never attending formal education. This educational profile implies potential barriers to accessing formal agricultural information and technology. However, most farmers possess 4–10 years of experience (54%), which enhances their practical knowledge and openness to adopting innovations that align with traditional farming wisdom.

Table 2. Characteristics of Variables and Sub-Variables

Criteria	%
Characteristics With Local Wisdom (X)	
Relative Advantage	
Economic Benefits	75
Technical Benefits	95
Compatibility	
Environmental conditions	94
Social and cultural conditions	93
Economic conditions	90
Adopter expectations and needs	95
Complexity	
Ease of application	92
Trials	
Small scale implementation	90
Observability	
Visible results	94
Criteria	
Adoption (Y)	%
Innovator	
Dare to take risks	15
Early adopters	
Starting innovation in groups	15
Majority beginning	
Many considerations	30
Late Majority	
Adopt a innovation with follow others	40

Table 2 illustrates the structural dimensions of innovation characteristics as perceived by farmers. Compatibility and observability achieved the highest recognition (over 90%), demonstrating that innovations aligning with environmental and socio-cultural values are more easily embraced. Farmers perceive the innovations as technically beneficial (95%) and economically advantageous (75%), particularly when they harmonize with indigenous farming norms. Regarding adoption stages, most farmers belong to the late

majority group (40%), reflecting a cautious but eventually accepting attitude once innovations prove successful within their community. This pattern underscores the importance of social demonstration effects and communal validation in the diffusion process of agricultural innovation.

Table 3. Reflective Measurement Model

Variables	CR	AVE
Relative advantage	0.868	0.767
Compatibility	0.885	0.658
Complexity	1,000	1,000
Trials	1,000	1,000
Observability	1,000	1,000
Adoption	0.864	0.613

Source: Primary Data Processed, 2024

Table 3 summarizes the reflective measurement properties of each construct, confirming that each latent variable representing innovation characteristics demonstrates strong internal consistency and convergent validity (CR > 0.70 and AVE > 0.60). This implies that the indicators used effectively capture farmers' perceptions regarding innovation dimensions such as compatibility, observability, and relative advantage.

Table 4. Formative Measurement Model

Indicator	VIF
Dare to take risks (Y1)	2.815
Starting innovation in groups (Y2)	2.905
Many considerations (Y3)	1,514
Following the trail (Y4)	1,566
Economic benefits (X1.1)	1,423
Technical benefits (X1.2)	1,423
Environmental conditions (X2.1)	1,775
Social and cultural conditions (X2.2)	2,347
Economic conditions (X2.3)	2.312
Adopter expectations and needs (X2.4)	2,055
Ease of implementation (X3)	1,000
Small scale implementation (X4)	1,000
Observable results (X5)	1,000

Source: Primary Data Processed, 2024

Table 4 provides the formative indicators for innovation characteristics and adoption behavior. The acceptable VIF values (<5) indicate no multicollinearity among indicators, affirming that each sub-variable contributes uniquely to the construct measurement. This reinforces the multidimensional nature of innovation characteristics, where cultural, social, economic, and technical aspects collectively influence adoption readiness.

Table 5. Q² Predictive Relevance

Indicator	RMSE	MAE	MAPE	Q ² _predict
Dare to take risks	0.744	0.600	23,547	0.241
Many considerations	0.638	0.545	19,716	0.354
Follow the crowd	0.629	0.560	20,362	0.419
Starting innovation in groups	0.798	0.654	25,408	0.128

Source: Primary Data Processed, 2024

Table 5 presents predictive relevance values for behavioral indicators associated with innovation adoption. The Q²_predict values (>0.1) signify that the model possesses adequate predictive capability for understanding how innovation characteristics, guided by local wisdom, shape different adopter categories. Farmers with strong communal ties and collective practices exhibit higher consistency in innovation uptake when innovations respect existing ecological and cultural systems.

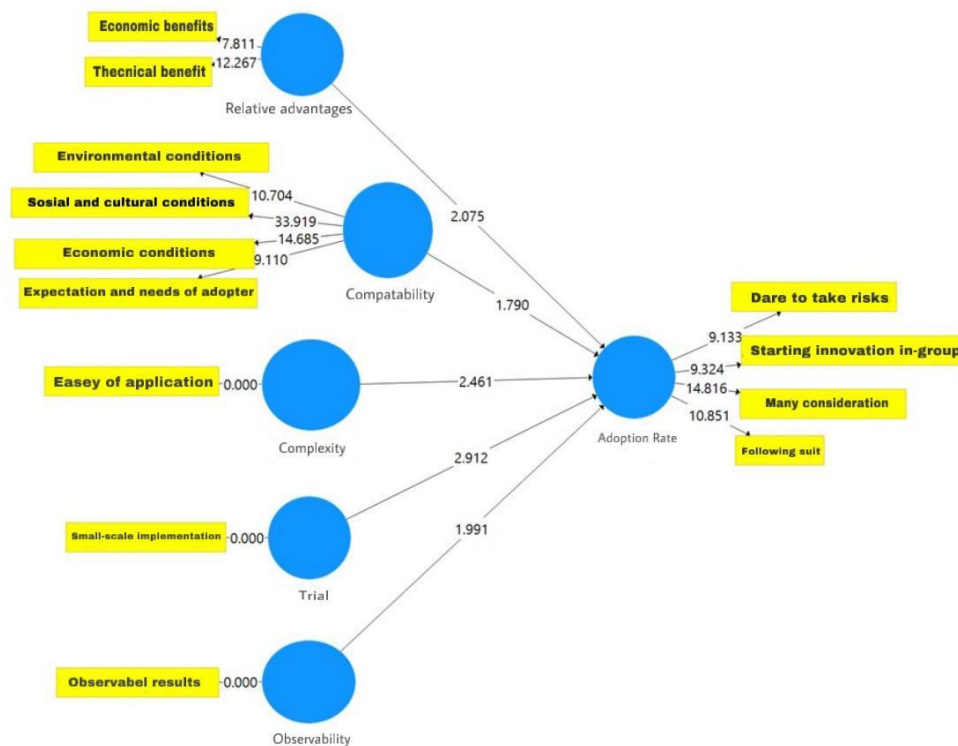


Figure 1. When Innovations Respect Existing Ecological and Cultural Systems

RESULTS AND DISCUSSION

Respondent Characteristics

As summarized in Table 1, the majority of respondents were male (58%), while female farmers represented 42%. This gender distribution illustrates that corn conservation farming remains largely male-dominated due to its physically demanding nature. However, women continue to play an essential complementary role, particularly in post-harvest management and financial planning of agricultural households. This reflects the persistent gender-based

labor division in rural agrarian systems. According to Nuraeni and Suryono (2021), women's contributions to agriculture are often underestimated, even though they play a critical role in sustaining household food security and agricultural productivity.

In terms of age, most respondents were between 36–50 years old (62%), indicating that the majority were in their productive age. Farmers in this age group generally possess sufficient physical capability and adaptive experience to implement innovative agricultural practices. Gusti et al. (2022) emphasize that middle-aged farmers tend to balance traditional farming knowledge with selective adoption of modern innovations, ensuring both stability and gradual progress in agricultural transformation.

Educationally, 36% of the respondents had completed elementary school, 23% junior high school, 15% senior high school, and only 1% had tertiary education, while 25% had never attended formal schooling. This suggests limited literacy levels that may hinder access to modern agricultural information and training opportunities. As noted by Sulvia and Nursalam (2020), low educational attainment correlates with restricted participation in technology-based agricultural programs, as literacy plays a pivotal role in understanding innovation guidelines. Similarly, Chairunnisa and Juliannisa (2022) argue that education significantly determines labor productivity and the ability to process information within the agricultural sector.

Meanwhile, 54% of respondents had been farming for 4–10 years, suggesting that most had substantial practical experience shaped by local knowledge systems. Erna Mena Niman (2019) asserts that such local wisdom functions as a vital repository of ecological and cultural intelligence, maintaining environmental balance while ensuring community resilience. Consequently, as Darwis (2020) observes, the socio-economic profile of smallholders remains rooted in traditional systems, where experience and inherited values strongly influence innovation adoption decisions.

Structural Model Analysis and the Relationship Between Innovation Characteristics

The structural model, constructed through Structural Equation Modeling (SEM), verified that the observed variables Innovation Characteristics (X) and Adoption (Y) fulfilled statistical validity and reliability standards ($CR > 0.7$; $AVE > 0.5$), with no multicollinearity issues ($VIF < 5$) (Epskamp, 2015). The coefficient of determination ($R^2 = 0.556$) indicates that 55.6% of the variance in the adoption of corn conservation innovation is explained by the combined influence of innovation characteristics integrated with local wisdom.

This outcome aligns with the diffusion of innovation framework proposed by Rogers, as cited by Astuti et al. (2019), emphasizing that the rate of adoption is determined by perceived relative advantage, compatibility, complexity, trialability, and observability. When innovations are perceived as beneficial, culturally appropriate, easy to apply, and demonstrably effective, farmers are more likely to adopt them.

Empirical patterns observed in the field show that farmers tend to rely on observable benefits such as visible yield improvement, reduced soil degradation, and increased cost efficiency before fully embracing an

innovation. This reflects a rational evaluation process shaped by collective experiences and environmental conditions, which are critical factors in community-based technology diffusion.

Integration of Local Wisdom into Innovation Characteristics

The findings strongly highlight the mediating function of local wisdom in the adoption of agricultural innovations. Innovations that align with local traditions, ecological conditions, and socio-cultural norms tend to be more widely accepted, as they reinforce rather than disrupt existing value systems (Wahyuni et al., 2019; Setiawan et al., 2021). Pesurnay (2018) emphasizes that adaptive local wisdom forms a dynamic interface between human activities and environmental systems, serving as a stabilizing mechanism in sustainable development.

1. Dominance of Observability

Among all indicators, observability demonstrated the highest influence on adoption behavior. Farmers showed greater confidence when the outcomes of an innovation could be directly observed in their peers' fields, such as improved soil fertility through organic composting or reduced erosion through contour planting. Wahyudi and Wulandari (2019) argue that observable results provide tangible proof, fostering trust and motivation among farmers to replicate successful practices. Hence, extension strategies emphasizing demonstration plots, visual results, and farmer-to-farmer learning are instrumental in enhancing adoption rates.

2. The Role of Compatibility

Compatibility emerged as the second most influential determinant. Most respondents perceived that the conservation technologies introduced were consistent with their socio-cultural and economic circumstances. High perceived compatibility with environmental (94%) and socio-cultural conditions (93%) reinforces the notion that innovations embedded in traditional values are more likely to be accepted. Runtiko et al. (2019) discovered a similar dynamic in the case of Srinthil tobacco farming, where technological persistence depended on ecological harmony and cultural integration. Therefore, innovation diffusion must prioritize adaptive alignment rather than abrupt transformation (Nasir et al., 2019), ensuring the sustainability of local farming systems.

3. Social Networks and the "Late Majority" Adoption Pattern

The predominance of the late majority (40%) among respondents signifies that innovation diffusion within rural communities often follows social rather than individual logic. Farmers tend to adopt new technologies only after observing others' success or due to collective influence within social groups. This aligns with Anjani et al. (2019) and Husien et al. (2019), who explain that social proof, a phenomenon where community consensus validates individual action, plays a decisive role in adoption decisions. Sirajuddin (2021) also notes that interpersonal trust, peer networks, and local leadership are key mediators of innovation diffusion in rural contexts.

Therefore, successful dissemination strategies should combine technological communication with social mobilization, utilizing farmer groups, community leaders, and peer-to-peer communication as core diffusion

channels. This approach, as supported by Destiani and Saridewi (2021) and FAO (2017), has been proven effective in building collective trust and accelerating technology transfer within traditional communities. Moreover, initiatives documented by Yayasan Planet Indonesia (2023) illustrate that participatory approaches rooted in local culture significantly enhance the sustainability of innovation programs.

Theoretical and Practical Implications

From a theoretical standpoint, this study reinforces Rogers' Diffusion of Innovation Theory, demonstrating that the adoption of innovation is shaped by a combination of innovation attributes, socio-cultural environments, and individual readiness. The role of local wisdom, as shown here, supports the argument by Wahyuni et al. (2019) that locally adapted innovations not only enhance productivity but also strengthen ecological and social sustainability.

Practically, these findings offer valuable insights for policymakers, agricultural extension officers, and development practitioners. Innovation programs should be designed to respect and integrate local cultural norms, build on traditional ecological knowledge, and utilize existing social networks as diffusion pathways. Soesanto (2022) and Adiyanta (2019) emphasize that community-based governance and context-sensitive policy frameworks are essential to ensure long-term sustainability. Meanwhile, Sugiyono (2017) and Mckim (2017) highlight that participatory and mixed-method research approaches are crucial for accurately capturing community perspectives and ensuring empirical reliability.

Ultimately, the integration of modern technology with local wisdom creates a hybrid innovation ecosystem that empowers farmers while preserving environmental balance. This synergy not only facilitates sustainable adoption but also fosters an inclusive agricultural transformation that aligns with socio-cultural values and ecological resilience.

FURTHER STUDY

Every research is subject to limitations; thus, you can explain them here and briefly provide suggestions for further investigations.

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