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Sustainable Agriculture Purchase Intention: The Moderating Role of Government Support in Farmers' Adoption of Green Product, Pheromone Mating Disruption for Rice Cultivation in Karawang

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ABSTRACT

Advancing sustainable agriculture requires farmer adoption of eco-friendly innovations such as pheromone mating disruption. This study analyzes how perceived benefit, perceived ease of use, and subjective norms shape farmers' green purchase intention, with government support as a moderator. Survey data from 211 rice farmers in Karawang were examined using SEM-PLS (SmartPLS 4.0). All three factors significantly increased purchase intention. Government support amplified the perceived benefit effect, diminished the ease of use impact, and did not influence subjective norms. By integrating TAM and TPB, this research offers rare empirical evidence from Indonesia's agricultural sector, highlighting the nuanced institutional role in the technology adoption of pheromone mating disruption. Findings inform targeted policy and marketing strategies for sustainable agriculture promotion.

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INTRODUCTION

Sustainable agriculture is increasingly recognized as a strategic priority to ensure food security while reducing environmental degradation (Badan Pangan Nasional, 2024) . In Indonesia, rice production remains central to national food policy, yet its cultivation is heavily reliant on synthetic pesticides. Such dependency has led to widespread ecological risks, including biodiversity loss, water contamination, and pest resistance, as well as health concerns for farming communities (Sharma & Foropon, 2019). The transition towards eco-friendly pest control is therefore essential to achieve multiple Sustainable Development Goals (SDGs), notably SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land).

Pheromone mating disruption (PMD) technology has emerged as a promising, environmentally benign alternative for managing rice stem borer infestations (M. Iqbal et al., 2023). This method releases synthetic sex pheromones into the crop environment, disrupting the ability of male insects to locate females, thereby preventing mating and reducing pest populations over time (Witzgall et al., 2010). Unlike broad-spectrum pesticides, PMD targets specific pest species, leaves no chemical residues, and preserves beneficial organisms, making it compatible with integrated pest management (IPM) programs and organic production standards (Ruan et al., 2024). In Indonesia, PMD was officially introduced in 2022, marking the first commercial deployment in both the country and the ASEAN region, with early market uptake exceeding initial projections.

However, adoption rates declined in the second year, highlighting a significant gap between farmers' awareness of the technology and their actual willingness to adopt it. Field observations indicate that while farmers acknowledge the environmental and health benefits of PMD, many remain hesitant due to perceptions of high cost, operational complexity, and lack of immediate visual effects compared to chemical pesticides (Puspitasari et al., 2024; Situmorang et al., 2021). These findings suggest that adoption is not solely determined by technology availability but also shaped by complex psychological, social, and institutional factors (Mustafa et al., 2022).

From an academic perspective, studies on green product purchase intention in agriculture remain limited in Indonesia. Existing literature primarily addresses consumer behavior in non-agricultural green products (Amin & Tarun, 2021; Zhuang et al., 2021), while research integrating both psychological and institutional determinants of adoption in farming contexts is scarce. Moreover, few studies have combined the Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) to analyze eco-friendly technology adoption in agriculture, despite evidence that perceived benefit, perceived ease of use, and subjective norms significantly shape behavioral intentions (Dai & Cheng, 2022; Jørgensen et al., 2024). This represents a notable research gap, particularly in the Indonesian agricultural setting.

Government support is widely acknowledged as a critical enabler for technology adoption in farming communities, providing policy frameworks, subsidies, extension services, and market incentives (Kalaitzandonakes et al., 2023; Mulia & Shihab, 2023). Yet, empirical findings remain mixed. While some

studies report a strong positive influence on green purchase intention, others indicate that inadequate or poorly targeted interventions can slow adoption (Lamourex et al., 2019). Understanding the nuanced moderating role of government support is therefore essential for designing effective policy and promotional strategies for sustainable agriculture.

This study addresses these gaps by examining how perceived benefit, perceived ease of use, and subjective norms influence farmers' purchase intention toward PMD, with government support as a moderating factor. Focusing on rice farmers in Karawang, one of Indonesia's most productive yet pesticide-intensive regions. This research integrates TAM and TPB to provide a comprehensive behavioral framework. The findings aim to contribute both theoretically, by advancing the understanding of eco-friendly technology adoption in agriculture, and practically, by informing targeted interventions that bridge the gap between awareness and adoption.

THEORETICAL REVIEW

Theoretical Background

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis in 1989 (Davis & Granic, 2024), posits that technology adoption is primarily driven by two perceptions: perceived usefulness (often operationalized as perceived benefit) and perceived ease of use. TAM has been widely applied in various sectors, including agriculture, to explain how these perceptions shape behavioral intentions (Akbar & Nurmahdi, 2019; Winata & Permana, 2020). Studies in green technology adoption show that ease of use not only influences perceived benefit but also enhances trust and reduces adoption barriers (Utama et al., 2024). Integrating TAM into the agricultural context allows for a structured understanding of how farmers evaluate eco-friendly technologies like pheromone mating disruption (PMD).

Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB), developed by Ajzen in 1991 (Ajzen, 2020), explains that behavioral intention is shaped by three core constructs: attitude toward the behavior, subjective norms, and perceived behavioral control. In agricultural contexts, TPB has been applied to understand farmers' willingness to adopt sustainable technologies, where attitudes reflect perceived benefits, subjective norms capture social influences, and perceived behavioral control relates to the perceived ease or difficulty of adoption (Hidayat et al., 2024; Masengu et al., 2025). TPB is highly adaptable and can incorporate additional factors such as environmental concern and willingness to pay, making it suitable for analyzing green product purchase intention in farming communities.

Perceived Benefit

Perceived benefit refers to the extent to which farmers believe PMD will provide positive outcomes, including higher yields, reduced pesticide use, improved environmental health, and compliance with market standards for

residue-free products (Amin & Tarun, 2021; Iqbal et al., 2023). Empirical findings indicate that when perceived benefits outweigh the required effort or cost, adoption intentions increase significantly (Winata & Permana, 2020), and perceived benefits might significantly increase the likelihood of adopting new technology (Akbar & Nurmahdi, 2019). In the context of green agriculture, a strong perceived benefit can offset initial skepticism toward novel technologies, especially those requiring behavioral adjustments.

H1: Perceived benefit positively influences green product purchase intention.

Perceived Ease of Use

Perceived ease of use, originating from the Technology Acceptance Model (Davis & Granic, 2024), refers to an individual's belief that a technology can be operated effortlessly without requiring substantial cognitive or physical effort. In agricultural contexts, it reflects farmers' ability to understand, operate, maintain, and integrate innovations such as pheromone mating disruption into existing practices. Studies by Utama et al., (2024), and Winata & Permana (2020), emphasize that ease of access and operation are critical to technology acceptance, while Ma et al., (2017) and Dai & Cheng, (2022) demonstrate its positive effect on sustainable agricultural technology adoption. García et al., (2020) further highlight that consumers associate ease of use with lower adoption barriers, making it a rational driver for green product purchase intention. Key indicators include technical simplicity, clarity of instructions, ease of learning, and product accessibility, which together form a decisive factor in accelerating adoption in farming communities.

H2: Perceived ease of use positively influences green product purchase intention.

Subjective Norms

Subjective norms describe the perceived social pressure from important referents such as family, peers, community leaders, or farmer group heads, that influence an individual's decision to adopt environmentally friendly technologies (Ajzen, 2020). In agricultural settings, these norms often emerge from horizontal, peer-to-peer interactions that shape adoption behaviors. Research by Doanh et al. (2021) and Masengu et al. (2025) shows that strong social endorsement significantly boosts green product purchase intention, even when perceived benefits are not fully established. Similarly, Huttel et al. (2020) and Wu et al. (2023) find that robust social norms can offset perceived risks or uncertainties surrounding new technologies. García et al. (2020); Maziriri et al. (2024); Witek & Kuźniar (2023) further underscore that legitimacy and trust are strengthened when recommendations come from close, trusted networks. In this study's context, such influence is reflected in peer advice, family encouragement, respected local figures' opinions, and community-based recommendations, all of which are vital levers for promoting sustainable agricultural adoption.

H3: Subjective norms positively influence green product purchase intention.

Government Support

Government support encompasses policies, subsidies, training programs, and extension services that facilitate adoption. In PMD adoption, it can strengthen perceived benefits by offering cost-sharing schemes, reduce complexity through hands-on training, and enhance legitimacy through

regulatory backing (Kalaitzandonakes et al., 2023). However, inconsistent or poorly targeted interventions may limit effectiveness (Lamourex et al., 2019).

H4: Government support moderates the relationship between perceived benefit and green product purchase intention.

H5: Government support moderates the relationship between perceived ease of use and green product purchase intention.

H6: Government support moderates the relationship between subjective norms and green product purchase intention.

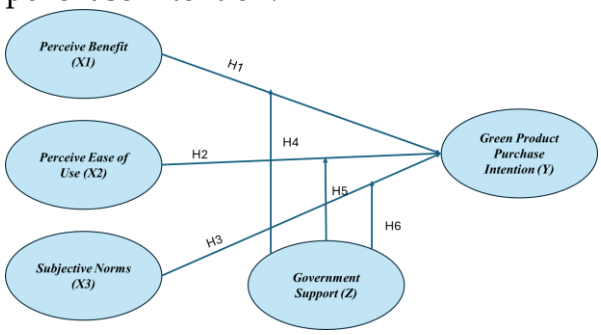

Figure 1. Conceptual Framework

METHODOLOGY

This research applies a robust quantitative causal design, strategically integrating the Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) to capture both psychological and technological determinants of farmers' green product purchase intention. Targeting one of Indonesia's most productive yet pesticide-intensive rice regions, 211 purposively selected farmers in Karawang provided primary data through carefully validated, interviewer-administered questionnaires, ensuring accuracy despite varying literacy levels. Leveraging the analytical power of Structural Equation Modeling–Partial Least Squares (SEM-PLS) in SmartPLS, the study rigorously tested measurement and structural models using AVE, HTMT, R^2, Q^2, and a 5,000-resample bootstrapping procedure. Moderation analysis of government support, enhanced with simple slope visualization, offers nuanced insights into policy leverage for sustainable technology adoption. This methodological rigor ensures both empirical robustness and practical relevance, positioning the study as a valuable reference for advancing sustainable agriculture strategies in emerging economies.

RESULTS

A total of 211 rice farmers from Karawang, Indonesia, participated in the study. The majority were male (99.1%), aged between 41–55 years, and had more than 10 years of farming experience, indicating a mature and seasoned respondent base. Most cultivated 0.5–1 hectares of land, with production cycles deeply embedded in conventional pest management practices. All respondents were aware of pheromone mating disruption (PMD) technology, having been introduced to it through agricultural extension programs, demonstration plots, or farmer group discussions.

In terms of educational attainment, the majority of respondents had completed Elementary school, followed by those with high school and junior high school education. A smaller proportion held diplomas or higher education degrees. This educational composition suggests a community with foundational literacy and numeracy skills, enabling them to understand new agricultural technologies, yet still benefiting greatly from hands-on demonstrations and visual learning.

Table 1. Respondent Description

Item	Category	Number	Percent	Item	Category	Number	Percent
Gender	Male	209	99.1%	Education Level	Below the elementary school	20	9.5%
	Female	2	0.9%		Elementary school	86	40.0%
Age	<30	9	4.3%		Junior high school	46	22.0%
	>50	37	17.5%		High school	54	26.0%
	31- 40	59	28.0%		Diploma	1	0.5%
	41- 50	106	50.2%		Bachelor	4	2.0%
Farming Experience	<5 years	27	12.8%	Land Ownership	<0.5 ha	28	13.3%
	5- 10 years	67	31.8%		0.5-1 ha	93	44.1%
	11- 20 years	79	37.4%		1-2 ha	64	30.3%
	>20 years	38	18.0%		>2 ha	26	12.3%

The outer loading assessment confirms that all indicators adequately represent their respective latent constructs, with values exceeding the 0.60 threshold and most surpassing the ideal 0.70 benchmark (Hair et al., 2022). These results indicate strong convergent validity and empirical robustness, validating that the measurement model is well-specified and suitable for subsequent discriminant validity testing and structural model evaluation.

Figure 2. Result of the structure models - Outer Loading

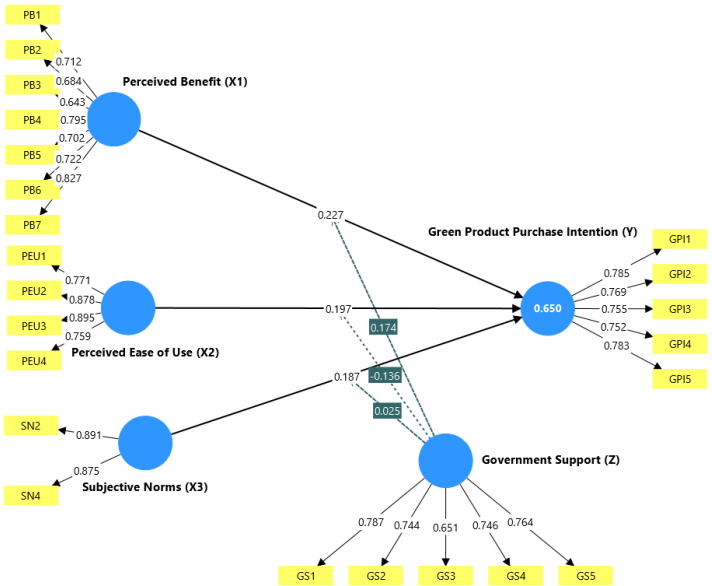

Table 2. AVE, Cronbach's alpha, and Composite Reliability Analysis

Construct	AVE	Cronbach's Alpha	Composite Reliability
Perceived Benefit (X1)	0.582	0.869	0.902
Perceived Ease of Use (X2)	0.658	0.849	0.892
Subjective Norms (X3)	0.779	0.794	0.874
Government Support (Z)	0.574	0.794	0.856
Green Product Purchase Intention (Y)	0.595	0.831	0.884

The convergent validity assessment shows that all constructs: Perceived Benefit, Perceived Ease of Use, Subjective Norms, Government Support, and Green Product Purchase Intention, achieved Average Variance Extracted (AVE) values above the 0.50 threshold, all meeting the minimum requirement (Hair et al., 2022). Eliability was established through Cronbach's Alpha (0.794–0.869) and Composite Reliability (0.856–0.902), both exceeding the 0.70 benchmark, indicating strong internal consistency. These results confirm that the measurement model is both valid and reliable, providing a solid basis for subsequent structural model analysis (Hair et al., 2022).

The HTMT assessment results indicate that all inter-construct correlation ratios are below the conservative threshold of 0.85, ranging from 0.674 to 0.834, thereby confirming discriminant validity in line with the recommendations of Henseler et al. (2015) and Hair et al. (2022). These values suggest that each latent variable is empirically distinct, ensuring that the constructs measure unique conceptual domains without redundancy. This reinforces the robustness of the measurement model and supports the theoretical distinctiveness of perceived benefit, perceived ease of use, subjective norms, government support, and green product purchase intention. As complementary evidence, the Fornell–Larcker criterion also confirms that the square root of each construct's AVE exceeds its correlations with other constructs, further validating discriminant validity.

Table 3. HTMT (Heterotrait-Monotrait) analysis

Variabel	***Perceived Benefit* (X1)**	***Perceived Ease of Use* (X2)**	***Subjective Norms* (X3)**	***Green Purchase Intention* (Y)**	***Government Support* (Z)**
Perceived Benefit (X1)					
Perceived Ease of Use (X2)	0,779				
Subjective Norms (X3)	0,772	0,644			
Green Purchase Intention (Y)	0,828	0,746	0,840		
Government Support (Z)	0,794	0,674	0,809	0,834	

Table 4. Inner Model Analysis

Variabel	R^2	R^2 adjust	Q^2
Green Product Purchase Intention (Y)	0,650	0,638	0,626

The inner model results show substantial explanatory power, with R^2 for Green Product Purchase Intention (GPPI) at 0.652, indicating that 65.2% of variance is explained by the predictors. Predictive relevance (Q^2) was 0.626, confirming the model's predictive capability.

Table 5. Hypothesis Analysis

Variabel	Koefisien	T Statistics	P Value	Result
Perceived Benefit (X1) -> Green Product Purchase Intention (Y)	0,227	2,579	0,010	Supported
Perceived Ease of Use (X2) -> Green Product Purchase Intention (Y)	0,197	3,151	0,002	Supported
Subjective Norms (X3) -> Green Product Purchase Intention (Y)	0,187	3,062	0,002	Supported
Government Support (Z) x Perceived Benefit (X1) -> Y_Green Product Purchase Intention	0,174	2,451	0,014	Supported positive moderation
Government Support (Z) x Perceived Ease of Use (X2) -> Green Product Purchase Intention (Y)	-0,136	2,516	0,012	Supported negative moderation
Government Support (Z) x Subjective Norms (X3) -> Green Product Purchase Intention (Y)	0,025	0,143	0,680	Not supported

The structural model results show that perceived benefit, perceived ease of use, and subjective norms each significantly enhance green product purchase intention. Government support strengthens the perceived benefit–intention link, negatively moderates the perceived ease of use–intention relationship, and insignificantly affects the subjective norms–intention path These findings illustrate the nuanced role of institutional support, where positive policy interventions can amplify value perceptions but may inadvertently reduce perceived autonomy in technology application.

DISCUSSION

The empirical results confirm that all three primary variables: perceived benefit, perceived ease of use, and subjective norms, significantly influence farmers' purchase intention toward pheromone mating disruption (PMD) technology. Furthermore, government support exhibits a nuanced moderating effect, enhancing the influence of perceived benefit while diminishing the effect of perceived ease of use and exerting no significant influence on subjective norms. These findings provide important theoretical and practical insights into the behavioral drivers and contextual enablers of sustainable agricultural technology adoption.

Perceived Benefit and Purchase Intention

The findings reveal that perceived benefit exerts a positive and significant influence on green product purchase intention, supporting the Technology Acceptance Model's (TAM) premise that perceived usefulness is a primary driver of technology adoption (Davis & Granic, 2024; Venkatesh & Bala, 2008). Farmers in this study, predominantly aged 35–50 with over a decade of experience, were more likely to adopt pheromone mating disruption (PMD) when its tangible advantages, such as reduced pest infestation, environmental safety, and long-term cost efficiency, were evident. These results align with Dai & Cheng (2022), who identified perceived benefit as the strongest predictor of eco-friendly agricultural technology adoption in China, and with Zhuang et al. (2021), whose meta-analysis found it to have the highest effect among green purchase intention determinants. Similar conclusions were reported by Maziriri et al. (2024) and Jijue et al. (2024), both emphasizing that measurable, productivity-linked benefits accelerate adoption.

From a practical standpoint, these insights underscore the importance of benefit-centered communication strategies. Highlighting field trial results, farmer testimonials, and measurable cost savings can strengthen the perceived value proposition, particularly in risk-averse farming communities. This is consistent with Akbar & Nurmahdi, (2019) and Winata & Permana, (2020), who noted that direct experience of tangible benefits significantly enhances acceptance of green innovations. By combining rational appeals (demonstrable economic and ecological gains) with social proof (endorsements from peers and community leaders), PMD providers can reinforce perceived benefit as both the initial driver of purchase intention and the foundation for long-term loyalty toward sustainable agricultural technologies.

Perceived Ease of Use and Purchase Intention

The results confirm that perceived ease of use has a positive and significant influence on green product purchase intention, indicating that the simpler an eco-friendly product is to operate, the greater the likelihood of its adoption. For pheromone mating disruption (PMD), ease of installation, minimal technical requirements, and clear instructions emerged as key adoption enablers. This finding aligns with the Technology Acceptance Model (Davis & Granic, 2024), which posits that perceived ease of use enhances perceived benefit and subsequently drives behavioral intention. Empirical support comes from Dai &

Cheng (2022) and Zhuang et al. (2021), who found that ease of use is a significant predictor of adoption in both agricultural and global green product contexts, as well as from Akbar & Nurmahdi (2019) and Utama et al. (2024), who highlight that simplified application processes lead to higher acceptance rates in rural farming systems. Demographically, most respondents were experienced farmers aged 30–50, preferring solutions that integrate seamlessly into existing routines, a trend also noted by Rezaei et al. (2020) in sustainable pest management adoption. These insights suggest that simplifying product design and providing practical, hands-on training can accelerate the adoption of sustainable agricultural technologies like PMD.

Subjective Norms and Purchase Intention

The results indicate that subjective norms have a positive and significant effect on green product purchase intention, reinforcing the Theory of Planned Behavior's assertion that social expectations are a key determinant of behavioral intention (Ajzen, 2020). In the context of sustainable agriculture, social influence from family members, fellow farmers, extension agents, and community leaders plays a decisive role in legitimizing the adoption of eco-friendly technologies such as pheromone mating disruption. This finding is consistent with Widiantari & Rachmawati, (2023), who reported a significant positive relationship between subjective norms and green purchase intention in Indonesia, and with Mai (2019), who found similar effects in Vietnam and Taiwan. It also aligns with Masengu et al. (2025), showing that sustainable farming practices are strongly influenced by local community norms, and with Savari & Gharechaee (2020), who demonstrated that social norms significantly shape farmers' decisions to adopt safer agricultural inputs. The demographic analysis further reveals that younger farmers and those with higher education levels tend to be more responsive to social influence, likely due to their greater engagement in social networks and digital platforms where sustainability information circulates. Collectively, these results underscore that strengthening peer endorsement and community-driven campaigns could be an effective strategy to accelerate green technology adoption in agriculture.

The Moderating Role of Government Support

The analysis demonstrates a multifaceted role of government support in moderating the relationships between key antecedents and green product purchase intention. First, government support significantly strengthens the effect of perceived benefit on purchase intention, acting as a leverage that amplifies farmers' valuation of pheromone mating disruption (PMD). Institutional backing in the form of subsidies, training, and protective regulations reinforces farmers' belief in the economic, ecological, and social benefits of PMD, consistent with findings by Dai & Cheng, (2022); Iqbal et al. (2024); Tan & Huang (2023); Yang et al. (2023), who emphasized the role of policy interventions in converting perceived value into adoption behavior.

From a socio-economic perspective, government support acts as a catalyst that transforms perceived value into concrete behavioral action. When farmers recognize tangible benefits, such as reduced pest damage, lower pesticide costs, and improved ecological outcomes, these perceptions are reinforced by accessible pricing policies, protective regulations, and hands-on technical assistance. The

effect is particularly pronounced among experienced farmers who have previously engaged in sustainable agriculture programs, reinforcing trust in both the technology and the supporting institutions. In this way, government involvement is not merely supplementary but serves as a critical leverage point that magnifies the perceived advantages of green technologies, embedding them into farmers' purchasing decisions and fostering long-term adoption.

In contrast, the moderating effect on perceived ease of use is significant but negative, suggesting that high levels of institutional facilitation can diminish the influence of usability on purchase intention. Under low government support, ease of use remains a strong adoption driver; however, when extensive external assistance is provided, its role becomes less critical. This counterintuitive pattern aligns with Liu & Tsaur (2020); Tan & Huang, (2023). who noted that excessive facilitation may substitute internal cognitive motivation, shifting reliance from product simplicity to structured external support.

From a theoretical standpoint, these results challenge the traditional Technology Acceptance Model (Davis & Granic, 2024), which posits that perceived ease of use should consistently foster adoption intention. In this case, high government involvement may shift farmers' decision-making from internal evaluation of usability toward reliance on external structures. Dai & Cheng (2022) note that policy incentives can accelerate adoption, but our findings suggest that overreliance on external support may dilute the impact of usability perceptions. This dynamic calls for a balanced approach where government assistance facilitates adoption while simultaneously nurturing farmers' confidence and autonomy in operating green technologies. For producers and distributors, enhancing the clarity, accessibility, and operational simplicity of pheromone mating disruption products remains critical to ensuring that ease of use retains its motivational power even in contexts of strong institutional support.

Finally, government support does not significantly moderate the relationship between subjective norms and purchase intention, indicating that social influence operates independently of institutional interventions. In cohesive farming communities, subjective norms are shaped more by peer-to-peer interactions, local leaders, and trusted networks than by formal programs. Farmers tend to be influenced more by family, local leaders, and fellow farmers than by formal government programs, a pattern consistent with the Theory of Planned Behavior (Ajzen, 2020), where subjective norms operate as independent determinants of behavioral intention. This aligns with Masengu et al. (2025) and Witek & Kuźniar (2023), who found that informal peer influence outweighs policy campaigns in shaping sustainable purchase behavior, particularly in tightly knit agricultural communities.

The parallel slopes observed in the simple slope analysis for both high and low government support conditions further confirm the absence of moderation, implying that strong social expectations can drive adoption intentions regardless of policy incentives. Similar insights are reported by García et al. (2020) and Maziriri et al. (2024), highlighting that community-based endorsements and shared success stories create higher legitimacy and adoption likelihood compared

to bureaucratic directives. In this study, subjective norms measured through peer, family, community leader influence, and farmer group recommendations proved more decisive than government-provided training, subsidies, or regulations. This suggests that strategies to promote green agricultural technologies, such as pheromone mating disruption, should prioritize strengthening horizontal social networks and leveraging respected local influencers, ensuring that adoption motivation stems from authentic community endorsement rather than institutional pressure.

Collectively, these findings suggest that while government support can be a powerful enabler in some contexts, its design and delivery must be carefully balanced. Over-facilitation may undermine intrinsic adoption drivers such as perceived ease of use, whereas peer-driven influence remains largely unaffected by institutional intervention. For policy and industry stakeholders, this underscores the need to complement formal support mechanisms with community-based diffusion strategies to maximize adoption impact.

CONCLUSIONS AND RECOMMENDATIONS

This study confirms that perceived benefit, perceived ease of use, and subjective norms each exert a positive and significant influence on green product purchase intention among rice farmers in Karawang, Indonesia. Government support plays a nuanced moderating role: it strengthens the effect of perceived benefit, weakens the influence of perceived ease of use, and has no significant interaction with subjective norms. These results highlight that while institutional backing can accelerate adoption by amplifying perceived value, over-facilitation may reduce the salience of usability as a driver, and peer-based social influence remains largely independent of formal interventions.

Practical and policy implications include the need for agricultural technology providers, such as pheromone mating disruption (PMD) producers, to center their marketing on tangible, farmer-verified benefits, supported by field demonstrations and community testimonials. Policymakers should calibrate support programs to build farmers' capacity for independent adoption, rather than fostering dependency, and reform subsidy schemes to prioritize environmentally friendly technologies. Collaborative ecosystems involving government, academia, industry, and farmer groups should be established to sustain knowledge transfer and improve accessibility to green innovations. Given that most farmers in this study had limited formal education, training, and communication materials should be practical, locally contextualized, and non-technical in delivery.

FURTHER STUDY

include the single-region focus, which limits generalizability. Future studies should expand to multiple agroecological zones with diverse socio-economic characteristics, and incorporate additional variables such as environmental knowledge, perceived risk, green trust, price sensitivity, and farmer experience as potential predictors or moderators. Such expansions could provide a more comprehensive understanding of behavioral drivers in

sustainable agricultural technology adoption and support the broader transformation toward environmentally responsible farming systems.

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