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Exploring the Intentions of White Pepper Farmers in Implementing Agroforestry: A Theory of Planned Behavior Approach in Central Bangka Regency

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ABSTRACT

Keywords: Agroforestry, Farmers' Intentions, Theory of Planned Behaviour, Muntok White Pepper.

Abstract

Agroforestry is a sustainable land-use approach that offers both ecological and economic benefits, including for strategic commodities such as Muntok White Pepper in Central Bangka Regency. However, the adoption rate of agroforestry among pepper farmers remains suboptimal, partly due to psychological factors. This study aims to analyze the psychological determinants of farmers' intentions to implement agroforestry using the Theory of Planned Behavior (TPB) framework, which includes three main constructs: attitude toward behavior, subjective norms, and perceived behavioral control. The study was conducted with an explanatory quantitative approach to 105 purposively selected white pepper farmers in Namang and Simpang Katis Districts. Data were collected through a structured questionnaire and analysed using multiple linear regression. The results of the analysis showed that attitudes towards behaviour and perception of behaviour control had a significant effect on farmers' intention to adopt agroforestry, while subjective norms did not have a significant effect. Attitude emerged as the most dominant predictor, highlighting the importance of

farmers' positive perceptions of agroforestry's benefits. These findings strengthen the applicability of TPB in agroforestry adoption research and provide policy implications for developing behavior-based extension strategies. Policy recommendations should focus on strengthening farmers' capacity and perceived ability rather than social pressure to enhance agroforestry implementation in white pepper farming systems.

INTRODUCTION

Agroforestry is recognized as a land management approach that integrates trees and agricultural crops within a single land unit. This system has been proven to enhance agricultural productivity sustainably (Mahmood & Zubair, 2020; Morais et al., 2025;Hailu, 2025), while also providing ecological benefits such as improved soil fertility, water conservation, and climate change mitigation, alongside economic benefits through farm product diversification (Nugroho et al., 2021; Octavia et al., 2022). As a tropical country, Indonesia holds significant potential for agroforestry development, including for high-value commodities such as Muntok White Pepper in Central Bangka Regency, Bangka Belitung Islands Province.

Muntok White Pepper is a strategic commodity with a significant role in the local economy (Pranoto et al., 2024;Pranoto et al., 2025). However, dependency on monoculture pepper farming increases vulnerability to price fluctuations and land degradation (Purwasih et al., 2020; Clément et al., 2023). Pepper-based agroforestry presents a more sustainable cultivation alternative. Unfortunately, its adoption in Central Bangka remains limited; of the total 1,948 hectares of pepper farmland, only 0.5% (or 9.92 hectares) has implemented agroforestry practices (Dinas Pertanian dan Ketahanan Pangan Provinsi Kepulauan Bangka Belitung, 2023).

The low adoption rate is not solely due to technical or economic barriers, but also psychological factors influencing farmers' decisions. White pepper farmers in Central Bangka are typically small-scale independent producers (Mustika et al., 2019;Pranoto et al., 2024). A study by Pranoto et al., (2025) found that perception influences farmers' adoption of Good Agricultural Practices (GAP) in pepper farming. Other research indicates that perceptions of risk, past experiences, social pressure, and self-efficacy significantly affect farmers' inclination to adopt new technologies (Ntawuruhunga et al., 2025;Faadhilah, 2024;Moure et al., 2024). Therefore, understanding farmers' intentions from a psychological standpoint is crucial to promoting effective agroforestry adoption.

The Theory of Planned Behavior (TPB) offers a conceptual framework to formulate farmers' intentions for adopting sustainable technologies by strengthening positive attitudes, perceived social norms, and perceived behavioral control (Retnaningtyas et al., 2024;Nugroho et al., 2021). In this study, the TPB approach is utilized to explain the psychological determinants influencing farmers' intentions to adopt agroforestry. TPB posits that intention is the primary predictor of behavior, shaped by three key variables 1) Attitude toward the behavior, referring to an individual's evaluation of the benefits or drawbacks of engaging in a particular action; 2) Subjective norms, or the perceived social pressure from the surrounding environment; and 3) Perceived behavioral control, which refers to the extent to which individuals believe they have the capacity or autonomy to perform the behavior (Ajzen, 1991; Semuroh & Sumin, 2021;Cao et al., 2022). TPB has been widely applied in studies of agricultural innovation adoption (Retnaningtyas

et al., 2024;Cao et al., 2022, Semuroh & Sumin, 2021), yet its application specifically to white pepper farmers in the context of agroforestry remains limited.

Most prior studies have focused on technical, economic, and biophysical aspects of agroforestry systems (Ntawuruhunga et al., 2025; Pauletto et al., 2025; Pancholi et al., 2023; Liu et al., 2019). In contrast, empirical research examining the influence of attitudes, subjective norms, and perceived behavioral control on agroforestry adoption intentions among white pepper farmers—particularly in Central Bangka Regency—is still scarce. To date, no predictive model based on TPB has been developed or tested within the socio-cultural context of local pepper farmers. This study specifically aims to measure the influence of attitude, subjective norms, and perceived behavioral control on the intentions of white pepper farmers to implement agroforestry in Central Bangka Regency. The research hypothesis posits that attitude, subjective norms, and perceived behavioral control significantly affect farmers' intentions to adopt agroforestry. This study is expected to contribute theoretically by expanding the application of TPB in the context of agroforestry adoption, and practically by informing the development of behavior-based extension and policy strategies in the Bangka Belitung Islands Province, a central production area for Muntok White Pepper.

RESEARCH METHODS

The study was conducted in the sub-districts of Namang and Simpang Katis, located in Central Bangka Regency, Bangka Belitung Islands Province. These areas were selected as they serve as major production centers for Muntok White Pepper and are target areas for agroforestry extension programs. The research was carried out from February to March 2025. The TPB model has been extensively used and proven effective in explaining innovation adoption behavior in the agricultural sector (Ajzen, 1991; Zubair et al., 2023)

This study employed a quantitative explanatory research design aimed at examining the causal relationships among variables within the Theory of Planned Behavior (TPB) framework, specifically investigating the influence of attitude toward agroforestry (X_1), subjective norms (X_2), and perceived behavioral control (X_3) on white pepper farmers' intention to adopt agroforestry (Y). The population consisted of all active white pepper farmers in Namang and Simpang Katis sub-districts who had previously participated in agroforestry training and extension programs, amounting to a total of 105 individuals. The sample was selected using purposive sampling based on the following criteria: active farmers who had cultivated pepper for a minimum of five years, had access to land suitable for agroforestry development, and had attended agroforestry extension programs. Since all individuals met these criteria, the study applied a limited census approach, wherein the entire eligible population was included as respondents (Sugiyono, 2022), which is considered adequate for multiple linear regression analysis.

Primary data were collected through interviews using a structured questionnaire based on a five-point Likert scale, covering the following indicators: 1) Attitude toward agroforestry, which includes perceptions of ecological and economic benefits, with response options ranging from strongly disagree, disagree, neutral, agree, to strongly agree, 2) Subjective norms, encompassing social support and environmental influences, with response options ranging from strongly unsupported, unsupported, neutral, supported, to strongly supported, 3) Perceived behavioral control, referring to technical capability, access to resources, and institutional support, with response options ranging from very unavailable, unavailable, neutral, available, to very available; and 4) Pepper farmers' intention, indicating farmers' willingness and readiness to adopt

agroforestry practices, with response options ranging from strongly unwilling, unwilling, neutral, willing, to strongly willing. The instrument was developed based on the indicators of the Theory of Planned Behavior (TPB) formulated by Ajzen (1991) and adapted from previous studies by Buyinza et al., 2020;Irwin et al., 2023; and Retnaningtyas et al., 2024. The Likert-scale data were transformed from ordinal to interval data based on the method proposed by Azwar S, (1995) and Azwar S, (2013). Instrument validation was conducted through content validity testing by involving relevant experts in the field of agroforestry. Reliability testing was performed using the Cronbach's Alpha method. The data were then analyzed using multiple linear regression to identify the influence of independent variables (X1, X2, X3) on the dependent variable (Y). The regression model used in previous studies (Ghozali, 2009; Pranoto & Sumiyati, 2022):

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$$

Description of variables:
Y= Pepper farmers' intention to adopt agroforestry
X_1 = Attitude toward agroforestry
X_2 = Subjective norms
X_3 = Perceived behavioral control
a = Constant

Prior to model interpretation, classical assumption tests were conducted, including normality, multicollinearity, and heteroscedasticity tests. Significance testing of the model parameters was carried out at a 5% significance level to evaluate the validity of the research hypotheses.

RESULTS AND DISCUSSION

This study aims to examine the influence of the three main constructs within the Theory of Planned Behavior (TPB) framework—including, attitude toward agroforestry (X1), subjective norms (X2), and perceived behavioral control (X3)—on pepper farmers' intention to adopt agroforestry (Y). The results of the overall model test showed a coefficient of determination (R^2) of 0.465, indicating that 46.5% of the variance in pepper farmers' intention to adopt agroforestry can be explained by the three independent variables included in the model. The regression ANOVA revealed that the regression model is statistically significant, with an F-value of 29.220 and a p-value < 0.001, suggesting that all three independent variables jointly contribute to the intention of pepper farmers to implement agroforestry. The partial regression test results are presented in Table 1.

Table 1. Results of regression test on the influence of attitude, subjective norms, and perceived behavioral control on pepper farmers' intention

Variable	Beta Coefficient	Sig. (p)	Description
(Constant)	2.720	0.543	
Attitude toward agroforestry (X_1)	0.685	0.001	Significant
Subjective norms (X_2)	0.067	0.471	Not significant
Perceived behavioral control (X_3)	0.174	0.037	Significant

Source: Primary data processed, 2025.

Note: α = 0.05

Table 1 demonstrates that attitude toward agroforestry and perceived behavioral control have significant effects on the intention of farmers to implement pepper agroforestry, whereas subjective norms do not. This finding aligns closely with global trends in the application of TPB within the agricultural sector.

The variable attitude toward agroforestry (X_1) shows a significant and positive influence on pepper farmers' intention to adopt agroforestry. This indicates that the more positively farmers perceive the ecological, economic, and land-use efficiency benefits of agroforestry, the stronger their intention to implement it. This finding is consistent with studies by Amare & Darr, (2023), who emphasized that farmers' positive attitudes are a major determinant in the adoption of agroforestry innovations. Similarly, Irwin et al., (2023) found that farmers' positive perception of oil palm agroforestry significantly influenced their adoption intentions. Tranchina et al., (2024) also concluded that perceived environmental benefits and prior experiences are key drivers in shaping positive attitudes toward agroforestry.

The variable perceived behavioral control (X_3) is also found to have a significant influence on farmers' intention to adopt agroforestry. Farmers who possess technical skills, access to resources, and sufficient institutional support are more likely to demonstrate a higher level of readiness to implement agroforestry practices. This finding is in line with research by Hendrawan & Musshoff (2024), which revealed that perceived control is strongly influenced by access to technical training, input support, and self-confidence in applying agroforestry practices, especially in oil palm contexts, which share similar characteristics with pepper cultivation. Furthermore, Irwin et al., (2023) and Leduc & Hansson, (2024) emphasized the importance of technical assistance and resource availability in building farmers' confidence in the success of agroforestry adoption. Therefore, strengthening perceived control through institutional support and capacity-building programs can be a key strategy to encourage wider implementation of pepper agroforestry.

Conversely, the results indicate that subjective norms (X_2) do not significantly influence farmers' intention to adopt agroforestry. This suggests that farmers' decisions to implement innovations are more influenced by internal factors, such as personal beliefs about their capabilities, technical capacity, and access to resources, rather than external pressures like social expectations or surrounding community opinions. Although subjective norms are considered a key determinant of behavioral intention in the TPB framework, this finding implies that social influence may be diminished by local sociocultural conditions. This conclusion is supported by Tega & Bojago, (2024), who noted that in societies with a high degree of individualism, social norms tend to have weaker influence, and decisions are more likely based on personal experience or rational evaluation. Similarly, Noeldeke et al., (2022) explained that social norms become effective only when the practice in question is already well-established and commonly practiced within the community. In this study's context, where pepper agroforestry is not yet a dominant practice, social norms may not exert a strong collective pressure on farmers' adoption intentions.

The findings of this study indicate that pepper farmers' intention to adopt agroforestry is significantly influenced by their attitude toward agroforestry and their perceived behavioral

control, while subjective norms do not have a significant impact. These results provide clear guidance for formulating more targeted and effective agricultural policies. Furthermore, farmers' attitudes are proven to be the most influential factor in shaping their intention to adopt agroforestry Amare & Darr, (2023) affirmed that positive attitudes toward the benefits of agroforestry enhance adoption intentions. Therefore, policies should aim to build farmers' confidence in the tangible advantages of this system. Recommended strategies include: (1) Establishing demonstration plots and identifying lead farmers to showcase the direct benefits of pepper-based agroforestry. (2) Conducting educational campaigns through extension workers, local media, and farmer forums to promote the economic, environmental, and land-efficiency benefits of agroforestry systems.

Perceived behavioral control also demonstrated a significant influence, indicating that although many farmers are willing to adopt agroforestry, they still feel insufficiently capable. Hendrawan & Musshoff, (2024) asserted that a strong sense of control (access and training) significantly enhances adoption intentions. Therefore, policy interventions should prioritize: (1) Technical training on pepper agroforestry practices, such as selecting appropriate shade trees, determining optimal planting distances, and implementing integrated fertilization. (2) Provision of initial inputs, including pepper seedlings, shade trees, and organic fertilizers, especially for smallholder farmers. (3) Continuous assistance through dedicated agroforestry extension agents who can provide direct field guidance.

Pepper-based agroforestry has not yet become a dominant social or cultural norm within farming communities. Tega & Bojago, (2024) emphasize that emerging social norms require reinforcement through community-based interventions. Therefore, policies should focus on: (1) identifying and empowering local farmer champions to act as influential social agents and symbols of successful agroforestry adoption. (2) Integrating agroforestry into farmer field schools, thereby fostering a new generation of farmers with agroecological perspectives.

CONCLUSION

Based on the research findings, it can be concluded that: First, attitude toward agroforestry has a highly significant influence and is the most dominant factor affecting pepper farmers' intention to adopt agroforestry. The more positive their attitude regarding the economic, ecological, and land-use efficiency benefits of agroforestry systems, the greater their intention to adopt such practices. Second, perceived behavioral control also significantly influences farmers' intention to adopt agroforestry. This highlights the importance of farmers' confidence in accessing resources, understanding technical aspects, and receiving the institutional support necessary for implementation. In contrast, subjective norms were found to have no significant effect, suggesting that adoption decisions are primarily individual and rational rather than driven by social pressure or expectations. Accordingly, effective approaches to increase agroforestry adoption among pepper farmers should focus on strengthening farmers' perceived benefits and capabilities, rather than relying on social norm enforcement

RECOMMENDATIONS

Based on the findings, it is recommended that the Department of Agriculture and relevant stakeholders in the pepper plantation sector develop intervention strategies that

emphasize strengthening individual farmers' attitudes and capacities. Outreach programs should be evidence-based, including the establishment of demonstration plots for pepper agroforestry and the dissemination of success stories from farmers who have effectively implemented the system. This approach is expected to build positive perceptions regarding the economic and ecological benefits of agroforestry. In addition, practical technical training and the provision of initial input support—such as shade tree seedlings, fertilizers, and other production facilities—should be intensified to enhance farmers' perceived control. The presence of specialized agroforestry extension officers who actively provide field assistance is crucial to strengthen farmers' confidence in adopting agroforestry practices sustainably. Furthermore, the formation of agroforestry-based farmer groups should be facilitated to foster farmer-to-farmer interaction and accelerate adoption through collective learning processes. Given that subjective norms were not found to significantly influence farmers' intention, symbolic approaches or social pressure-based interventions are not recommended as the main focus. Instead, intervention resources would be more effectively allocated to improving farmers' perception of benefits and technical capabilities.

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