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Adopting Paludiculture as a Farming Model Resilient to Climate Change: Insights from Farming Communities in the Peatlands of South Sumatra, Indonesia

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ABSTRACT

Paludiculture, which involves growing crops and managing forests on rehydrated peatlands, is seen as a viable option to balance agricultural production with peatland conservation. However, the adoption of this practice by farmers remains inconsistent. This study investigated factors related to socioeconomic status and behavior that influence paludiculture adoption among communities living in peatland areas in Ogan Komering Ilir (OKI) Regency, South Sumatra, Indonesia. We surveyed n = 150 farmers and used Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess how perceived usefulness (PU), perceived ease of implementation (PEI), institutional support (IS), economic capacity (SEC), and perceived climate risk (PCR) influenced adoption intention (AI) and actual adoption (AA) of the practice. Our findings indicate that adoption intention is positively correlated with perceived usefulness ($\beta = 0.34$, $p < 0.01$) and perceived ease of implementation ($\beta = 0.26$, $p < 0.05$). In contrast, perceived climate risk negatively impacted intention ($\beta = -0.23$, $p < 0.05$). Institutional support contributed positively, albeit to a lesser extent ($\beta = 0.17$, $p < 0.10$), while economic capacity had a slight positive correlation ($\beta = 0.19$, $p \approx 0.10$). Intention to adopt was a strong predictor of actual adoption ($\beta = 0.48$, $p < 0.01$). The model explained 56% of the variance in adoption intention ($R^2 = 0.56$) and 38% of the variance in actual adoption ($R^2 = 0.38$). These results suggest that promoting paludiculture

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ARTICLE INFO
Received: Day Month Year | Revised: 21 April 2026 | Accepted: 28 April 2026 | Published Online: 5 May 2026
DOI: https://doi.org/10.55121/nc.v5i3.1125

CITATION
Pusvita, E., Hermawati, L., Gribaldi, 2026. Adopting Paludiculture as a Farming Model Resilient to Climate Change: Insights from Farming Communities in the Peatlands of South Sumatra, Indonesia. New Countryside. 5(3): 25–38. DOI: https://doi.org/10.55121/nc.v5i3.1125

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will require increasing perceived economic benefits, reducing concerns about risks through ongoing training and demonstrations, and improving supporting conditions such as extension services and financing. Policies that combine technical assistance with institutional support and market development are likely to accelerate adoption and enhance climate resilience in peatland farming systems.

Keywords: Climate Resilience; Paludiculture; Peatlands; Technology Adoption

1. Introduction

Tropical peatlands are currently facing two critical policy challenges: enhancing climate resilience within the agricultural sector and revitalizing damaged wetland ecosystems [1,2]. In numerous peat areas, farming households deal with significant production risks caused by unstable water conditions, extreme weather, and frequent disruptions, which affect planting schedules, resource usage, and market accessibility [3,4]. These risks are not solely related to physical factors but also influence income reliability and farming choices, particularly in regions with limited livelihood alternatives and land ownership governed by local authorities and tightly controlled supply chains [5,6].

Paludiculture, which involves wet farming and forestry practices on re-wetted peatlands, has been advocated as a viable solution for harmonizing agricultural activities with peat restoration efforts [7–9]. This method theoretically enables ongoing production while preserving high groundwater levels, thereby alleviating degradation pressures and enhancing long-term ecosystem health [10]. Nevertheless, the shift from traditional farming practices on peatlands to paludiculture is not straightforward or merely a technical issue [11–13]. Farmers must modify their planting strategies, redistribute labor and resources, and become accustomed to new crops, production methods, or harvesting practices [14,15]. This transition is often seen as risky, particularly for farmers who have limited information, insufficient support from extension services, and uncertain expectations of profit [16].

South Sumatra, particularly in Ogan Komering Ilir Regency (OKI), the primary challenge lies not merely in determining “which paludiculture model should be used,” but also in understanding “the conditions under which farmers are willing and able to adopt it.” Field observations and previous studies [17–19] indicate that barriers to paludiculture adoption are strongly linked to human and institutional factors, including limited knowledge, weak extension services, negative perceptions of peatland farming, and economic uncertainty. The grant roadmap suggests that barriers to adoption are closely linked to human and institutional elements, including farmers’ limited knowledge about paludiculture, inadequate government outreach, negative views about peatland farming, and economic uncertainties associated with paludiculture. These challenges indicate that the degree of paludiculture implementation cannot be fully understood solely through agronomic technical factors; rather, it must be viewed as a behavioral and socioeconomic choice made under conditions of uncertainty.

Within the field of agricultural economics, the process of adopting technology has long been recognized as a decision-making journey that hinges on how individuals evaluate the anticipated advantages in relation to the expenses, risks, and limitations they encounter [18–21]. Farmers often postpone adopting new methods when they lack sufficient information, when profit margins are unpredictable, or when there is inadequate support, such as access to loans, education, and markets. Moreover, choices about adoption are further shaped by individual perceptions, societal standards, and their level of trust in the regulatory institutions overseeing agricultural methods. When it comes to managing peatlands, these behavioral aspects are especially critical since land management is intricately tied to water governance, collective action within communities, and frequently shifting policy indications. For instance, if farmers view restoration methods as detrimental to productivity or as incurring higher immediate costs, their willingness to adopt these practices tends to decrease, regardless of the genuine long-term advantages [22–25].

Several global studies have introduced behavioral and socio-technical models, including the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), to clarify the innovation adoption process in agriculture [26–29]. These models highlight that the adoption journey begins with intentions and attitudes based on perceived usefulness, ease of use, available support systems, and social influences [30]. Nevertheless, there is still a scarcity of empirical data on how these elements function specifically in peatland contexts, despite the fact that farming methods in wetland areas are significantly affected by water conditions, institutional regulations, and the readiness of value chains [31–33]. Addressing this knowledge gap is crucial because peat restoration initiatives often operate under the assumption that "green" practices will be readily embraced once presented; however, the reality is that on-the-ground implementation remains low due to insufficient funding, training, and social change strategies that resonate with local customs [34–37].

Field research findings and the OIC paludiculture research framework indicate persistent barriers that hinder higher adoption rates, such as the limited execution of paludiculture methods, restricted access to financial resources, insufficient training opportunities, and socio-cultural challenges within communities [38]. This situation highlights the necessity for a comprehensive analysis that connects (i) farmers' views and motivations, (ii) supportive resources like funding and guidance, and (iii) the actual rates of adoption observed. Such an analysis is anticipated to yield policy insights that are not just anecdotal but grounded in empirical data, which can be utilized to prioritize interventions, whether that involves enhancing extension programs, bolstering training, mitigating perceived risks, or harmonizing incentives between institutions and local markets.

This research investigates the social, economic, and behavioral elements that influence the willingness of farmers in the peatlands of South Sumatra to adopt paludiculture methods. Following the guidelines set by Studies in Agricultural Economics (Instructions for Authors), this introductory section outlines the context and aims of the research while referencing the global scholarly work without conducting an excessively detailed literature overview. The primary aim of this investigation was to discover and evaluate the social and behavioral factors that influence the intentions and actions surrounding the adoption of paludiculture, and to analyze the results as policy insights for developing agricultural systems in peatlands that are resilient to climate change.

This research offers contributions in three different ways. To begin with, the research introduces agricultural methods based on peat restoration within the realm of agricultural economics, particularly focusing on how farmers adjust to sustainable production practices. Secondly, it highlights the significance of perceptions and supportive conditions that are frequently discussed in policies but are often not evaluated through empirical data at the household level of farmers. Lastly, by concentrating on farming communities in the peatlands of South Sumatra, this research supplies evidence regarding strategically significant areas for employing climate-resilient land, where the adoption trends vary greatly from those in mineral soil farming systems due to their hydrological and institutional complexities.

2. Conceptual and Theoretical Framework

The analytical framework for this research was formulated based on the theory of the adoption of agricultural innovations, specifically the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). In the context of paludiculture, farmers' decisions to embrace a wet farming system are viewed as a behavioral process influenced by perceptions, economic capabilities, and institutional support.

The primary latent variables in this research include:

1. Perceived Usefulness (PU): the view of the economic and ecological advantages of paludiculture.
2. Perceived Ease of Implementation (PEI): the technical simplicity of applying wet farming systems.
3. Institutional Support (IS): backing from government entities, extension agents, financial organizations, and farmer groups.
4. Socioeconomic Capacity (SEC): the resource capabilities of farming households (education, capital, land size, experience).

5. Perceived Climate Risk (PCR): perceptions regarding climate-related risks such as fires and crop failures.
6. Adoption Intention (AI): the desire to adopt paludiculture.
7. Actual Adoption (AA): the degree of real adoption occurring in practice.

The connections between these variables were examined within a structural model framework utilizing the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. Analysis Method. The analysis will proceed in several phases:

1. A descriptive analysis was performed to recognize the socio-economic traits of the participants, their views on paludiculture, and the rates at which they have adopted it.
2. Evaluation of construct validity and reliability was undertaken, which included tests for loading factors, Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE).
3. Assessment of structural models (inner models) was done to examine the relationships between latent variables through path coefficients and significance levels (*p*-values).
4. The evaluation of goodness-of-fit utilizes R^2, Q^2, and SRMR (Standardized Root Mean Square Residual) values. The overall analysis was executed using SmartPLS software version 4.0 alongside SPSS version 26.0 to facilitate further statistical examinations (correlation tests and tests for differences in means).

3. Methodology and Sources

This research took place in the Ogan Komering Ilir Regency (OKI) in South Sumatra Province, Indonesia. This area is known for having one of the largest peat ecosystems on the island of Sumatra and is a key target of the national program for peat restoration. The region's land is often susceptible to drought and fires, yet it also has potential for development using paludiculture-based wet farming methods. This investigation employs a quantitative method with a cross-sectional survey design. This method was selected to gather an empirical view of the social, economic, and institutional elements that affect how quickly paludiculture is adopted by farming households living in peatland areas.

The primary data utilized came from direct interviews with participants through a structured questionnaire. The questionnaire focused on demographic details, views on the advantages and disadvantages of paludiculture, institutional assistance, and behaviors related to adoption.

Sampling was performed using a multistage random sampling technique, which involved the following steps: The sub-districts were chosen purposefully from areas that already have peat restoration efforts or operational paludiculture projects, such as Tulung Selapan, Pedamaran, and Pampangan. Within each sub-district, two to three villages with varying social characteristics and peat ecosystems were selected. From each village, respondents were chosen randomly, proportionate to the number of farming households. The total number of respondents matched 150 farming households, which is considered sufficient to portray the socio-economic conditions and behaviors surrounding paludiculture adoption locally. Apart from primary data, secondary information was gathered from local government departments, the BRGM Research and Development Center, and scholarly works connected to the adoption of agricultural technologies in wetland areas.

The sample size of 150 respondents is considered adequate for Partial Least Squares Structural Equation Modeling (PLS-SEM). According to the "10-times rule", the minimum sample size should be at least ten times the largest number of structural paths directed at a latent construct in the model. In this study, the maximum number of predictors influencing a single construct is five, suggesting a minimum sample size of 50 respondents. Therefore, the sample size of 150 provides sufficient statistical power for model estimation and hypothesis testing.

The information acquired from the questionnaire first undergoes a data cleaning process (which involves verifying the completeness of responses, ensuring consistency in completion, and identifying outliers). Items on the Likert scale are assigned numerical values from 1 (strongly disagree) to 5 (strongly agree). Socio-economic factors (like age, education, land size, farming history, and income) are processed in numeric format and/or classified into categories based on the analysis needs.

The analysis was conducted in three phases. Initially, descriptive analysis was applied to illustrate the profiles of respondents, their understanding and views on paludiculture, availability of training or counseling, and their actual rates of adoption. The results of the descriptive analysis are presented as averages, percentages, and the distribution of adopter types (such as non-adopters, partial adopters, and full adopters).

(1) Measurement Model (Outer)

a) Reflective Constructs (typically PU, PEI, IS, PCR, AI)

For every indicator x or y:

1. Indicators for external constructs (x-blocks):

$$x_{ij} = \lambda_{xj}\,\xi_i + \delta_{ij}$$

2. Indicators for endogenous constructs (y-block):

$$y_{ik} = \lambda_{yk}\,\eta_i + \varepsilon_{ik}$$

Description:

ξ_i = score of exogenous latent constructs (e.g., PU, PEI, IS, SEC, PCR) in the first respondent;

η_i = endogenous latent construct score (e.g., AI, AA) in the 1st respondent;

λ = Loading indicator;

δ, ε = measurement error;

If you're writing more concisely, just one reflective form:

$$\text{Indicator} = \lambda(\text{Construct}) + \text{Error}$$

b) If your SEC treats it as formative (optional)

If the SEC is built from components (capital, land area, etc.) that "form" capacity, not "reflect", the formula:

$$SEC_i = \sum_{j=1}^{m} w_j x_{ij} + \zeta_i$$

w_j = weight indicator formative;

ζ_i = error.

(2) Structural Model

Your piece discusses how PU, PEI, IS, SEC, and PCR affect Adoption Intent (AI), and how AI impacts Actual Adoption (AA).

Equation (1): Factors influencing adoption intent:

$$AI_i = \beta_1\,PU_i + \beta_2\,PEI_i + \beta_3\,IS_i + \beta_4\,SEC_i + \beta_5\,PCR_i + \zeta_{1i} \quad (1)$$

Equation (2): Determinants of actual adoption:

$$AA_i = \gamma_1\,AI_i + \zeta_{2i} \quad (2)$$

(3) If You Wish to Add Immediate Impacts (This Is Optional for Strength)

Occasionally, reviewers inquire about examining if support or capacity influences actual adoption directly (as opposed to merely through intent). Therefore:

$$AA_i = \gamma_1\,AI_i + \gamma_2\,IS_i + \gamma_3\,SEC_i + \zeta_{2i}$$

(4) Mediation Formula (for Outcomes Report)

If you evaluate AI mediation, then:
Indirect Effects:

$$PU \rightarrow AI \rightarrow AA$$
$$IE_{PU} = \beta_1 \times \gamma_1$$

Total effect:

$$TE_{PU} = DE_{PU} + IE_{PU}$$

with DE_{PU} = direct effect (if there is a direct path of $PU \rightarrow AA$).

(5) How to Compose Concisely

You might formulate a single paragraph: "Models of structure evaluate the effect on, in addition to the effect on, based on Equations (1) and (2). The estimation is performed by utilizing PLS-SEM with bootstrapping to derive path coefficients and their significance." PU, PEI, IS, SEC, PCRAIAIAA.

Figure 1 illustrates the conceptual framework examining factors influencing the adoption of paludiculture as a climate-resilient farming model among peatland farming communities in South Sumatra, Indonesia. Perceived Usefulness (PU), Perceived Ease of Implementation (PEI), Institutional Support (IS), Socioeconomic Capacity (SEC), and Perceived Climate Risk (PCR) are hypothesized to influence Adoption Intention (AI). Furthermore, Adoption Intention (AI) is expected to positively affect Actual Adoption (AA). The relationships among variables are represented by path coefficients β_1–β_5 and γ_1.

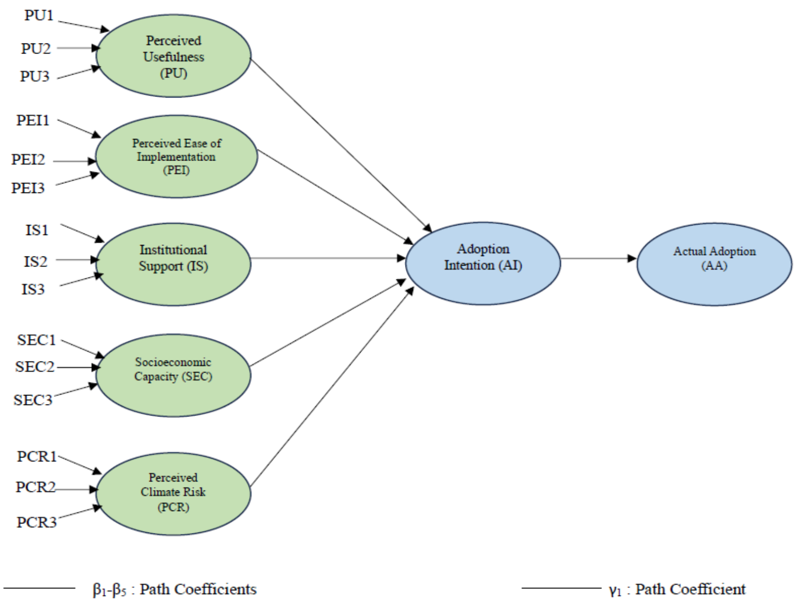

Figure 1. Conceptual framework for adopting paludiculture as a climate-resilient farming model.

(6) Variable Measurement

Actual adoption (AA) refers to the extent to which farmers have implemented paludiculture practices in their farming activities. In this study, adoption was measured based on farmers' self-reported implementation of paludiculture crops and cultivation techniques adapted to peatland conditions. Respondents were classified into three categories:

1. Non-adopters—farmers who have not implemented paludiculture practices;
2. Partial adopters—farmers who have experimented with paludiculture crops on a limited scale;
3. Full adopters—farmers who have integrated paludiculture crops as a regular part of their farming system.

This classification enables a clearer understanding of the adoption level among farming households.

4. Results and Discussion

4.1. Characteristics of Respondents

A significant number of respondents were farmers within the productive age range of 35 to 55 years, averaging about 15 years of experience in cultivating peatlands (**Table 1**). Approximately 68% of these individuals had only achieved basic education levels, spanning from elementary to junior high, whereas 22% had completed secondary education. The primary source of income for most respondents was swamp rice farming, along with other potential crops from paludiculture such as purun, areca nut, or kelakai. A mere 30% of the respondents had participated in training related to peatland management or paludiculture, and roughly 18% accessed farming finances. This highlights that, overall, the socio-economic status of farmers remains low, characterized by limited opportunities for training, guidance, and institutional assistance. This observation is consistent with the OIC paludiculture research framework, which indicates that inadequate training and dissemination pose significant challenges to implementing peat-based farming techniques.

Table 1. Respondent characteristics.

Variable	Category	Percentage
Age	35–55	65%
Education	Primary	68%
Training	Yes	30%

4.2. Descriptive Analysis of Paludiculture Perceptions

The majority of farmers held a favorable view regarding the environmental advantages of paludiculture, with an average perception score of 4.2 out of 5, particularly in relation to the reduction of fire risks and the preservation of soil moisture. Conversely, opinions on the economic advantages illustrated more diversity, with an average score of 3.4. Farmers expressed skepticism about paludiculture's ability to yield consistent profits or compete favorably against traditional agricultural practices. The ease of applying these methods garnered a moderate rating, reflected in an average score of 3.6, indicating limitations in technical skills and knowledge for managing wet farming techniques. Additionally, the perception of climate risks was considerably high, averaging a score of 4.1, particularly due to concerns regarding flooding and unpredictable extreme weather. This evidence supports the notion that decisions to adopt new methods are largely shaped by perceptions of benefits and risks, along with the degree of technological preparedness and external assistance [39].

4.3. Results of SEM-PLS Model Estimation

The measurement model's test results revealed that all constructs showed a loading factor exceeding 0.70, alongside an AVE value greater than 0.50, which suggests strong convergent validity. The overall Composite Reliability (CR) value across all constructs was above 0.80, indicating robust internal reliability. No multicollinearity issues were detected, as VIF values remained below 5.

In the structural model, the estimation outcomes resulted in the following equations:

$$AI = 0.34\ PU + 0.26\ PEI + 0.17\ IS + 0.19\ SEC - 0.23\ PCR$$

$$AA = 0.48\ AI$$

With appropriate institutional support, market development, and farmer capacity building, paludiculture has the potential to become an important strategy for promoting climate-resilient agriculture in peatland ecosystems.

Figure 2 illustrates the structural model estimation results obtained from the PLS-SEM analysis. The figure shows the relationships among the latent constructs and the magnitude of the path coefficients linking the determinants of paludiculture adoption.

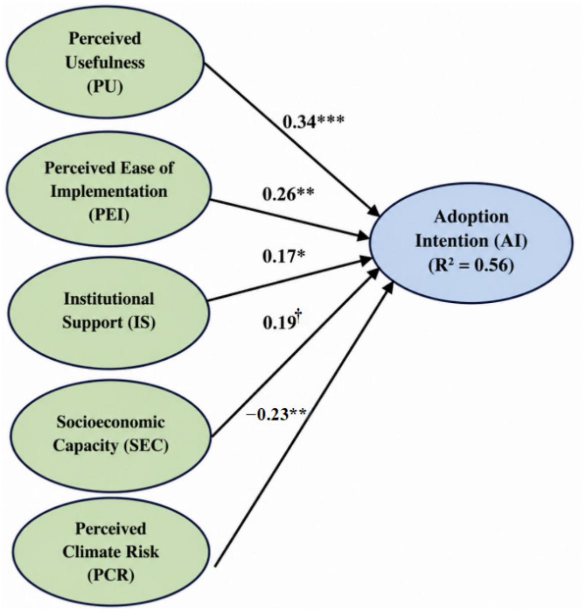

Figure 2. Determinants of paludiculture adoption intention.

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$; † marginal.

As shown in **Figure 3**, the measurement model demonstrates satisfactory indicator loadings across all constructs, supporting the reliability and validity of the proposed model.

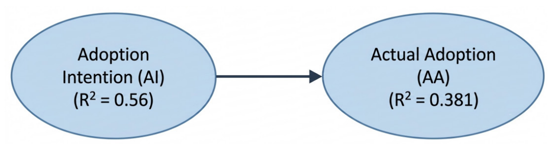

Figure 3. From intention to actual adoption (PLS-SEM).

Figure 4 presents the bootstrapping results used to evaluate the significance of the hypothesized relationships. The results confirm that several constructs significantly influence farmers' adoption intentions toward paludiculture.

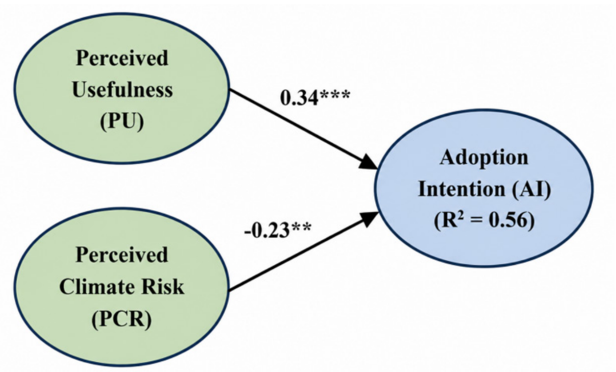

Figure 4. Effect of perceived usefulness and climate risk.

Note: *** $p < 0.01$; ** $p < 0.05$.

Figure 5 illustrates the final structural model and highlights the direct effects among the latent variables. The figure provides a visual summary of the factors influencing actual adoption of paludiculture practices in peatland farming communities.

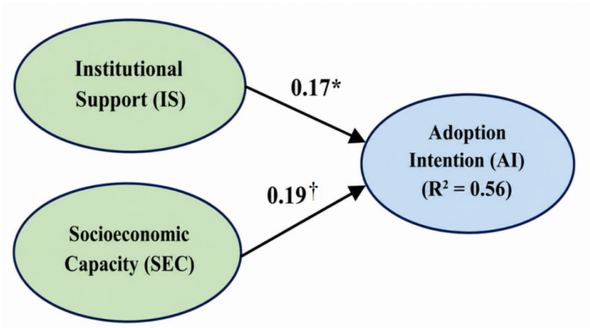

Figure 5. Effect of institutional support and socioeconomic capacity.

Note: * $p < 0.10$; † marginal.

The results of the PLS-SEM analysis are presented in **Table 1**. The findings indicate that Perceived Usefulness (PU) has the strongest positive effect on Adoption Intention (AI) (β = 0.34; $p < 0.01$), followed by Perceived Ease of Implementation (PEI) (β = 0.26; $p < 0.05$). Institutional Support (IS) shows a positive but weaker influence (β = 0.17; $p < 0.10$), while Socioeconomic Capacity (SEC) has a marginally significant effect (β = 0.19; $p \approx 0.10$).

In contrast, Perceived Climate Risk (PCR) negatively affects Adoption Intention (β = −0.23; $p < 0.05$), indicating that higher perceived risks reduce farmers' willingness to adopt paludiculture practices.

Furthermore, Adoption Intention (AI) significantly influences Actual Adoption (AA) (β = 0.48; $p < 0.01$), confirming that intention is a strong predictor of actual behavior. The model explains 56% of the variance in Adoption Intention ($R^2 = 0.56$) and 38% of the variance in Actual Adoption ($R^2 = 0.38$), indicating moderate explanatory power.

Table 2 presents the results of the structural model assessment. The findings indicate that Perceived Usefulness (PU) has the strongest positive effect on Adoption Intention (AI) (β = 0.34, $p < 0.01$), followed by Perceived Ease of Implementation (PEI) (β = 0.26, $p < 0.05$). Institutional Support (IS) and Socioeconomic Capacity (SEC) also show positive effects, although their influence is relatively weaker. In contrast, Perceived Climate Risk (PCR) negatively affects Adoption Intention (β = −0.23, $p < 0.05$). Furthermore, Adoption Intention (AI) significantly influences Actual Adoption (AA) (β = 0.48, $p < 0.01$), indicating that farmers' intention to adopt paludiculture is a strong predictor of actual implementation. The structural model demonstrates moderate explanatory power. As shown in **Table 2**, the model explains 56% of the variance in Adoption Intention ($R^2 = 0.56$) and 38% of the variance in Actual Adoption ($R^2 = 0.38$). These results suggest that the proposed constructs provide a satisfactory explanation of farmers' adoption behavior toward paludiculture practices.

Table 2. Convergent validity.

Pathway	Coefficient (β)	Significance
PU → AI	0.34	$p < 0.01$
PEI → AI	0.26	$p < 0.05$
IS → AI	0.17	$p < 0.10$
SEC → AI	0.19	marginal
PCR → AI	−0.23	$p < 0.05$
AI → AA	0.48	$p < 0.01$

And the model's fit value is:

1. R^2 (Adoption Intent) = 0.56;
2. R^2 (Actual Adoption) = 0.38.

Table 3 presents the results of the measurement model evaluation. The measurement model was assessed to examine the reliability and validity of all constructs. The results indicate that all indicator loadings exceeded the recommended threshold of 0.70, demonstrating satisfactory indicator reliability. Internal consistency reliability was confirmed, as Cronbach's Alpha values ranged from 0.78 to 0.85 and Composite Reliability (CR) values ranged from 0.85 to 0.90, all exceeding the recommended minimum threshold of 0.70. Furthermore, convergent validity was established because all Average Variance Extracted (AVE) values were above 0.50, indicating that each construct explains more than 50% of the variance of its indicators. Overall, the results shown in **Table 3** confirm that the measurement model satisfies the criteria for reliability and convergent validity.

Table 3. Measurement model evaluation.

Construct	Indicator	Loading	Cronbach's Alpha	Composite Reliability (CR)	AVE
Perceived Usefulness (PU)	PU1	0.78	0.82	0.88	0.65
	PU2	0.81			
	PU3	0.83			
Perceived Ease of Implementation (PEI)	PEI1	0.75	0.80	0.87	0.62
	PEI2	0.79			
	PEI3	0.82			
Institutional Support (IS)	IS1	0.76	0.79	0.86	0.61
	IS2	0.80			
	IS3	0.78			
Socioeconomic Capacity (SEC)	SEC1	0.74	0.78	0.85	0.59
	SEC2	0.77			
	SEC3	0.80			
Perceived Climate Risk (PCR)	PCR1	0.81	0.83	0.89	0.67
	PCR2	0.84			
	PCR3	0.79			
Adoption Intention (AI)	AI1	0.82	0.85	0.90	0.69
	AI2	0.85			
	AI3	0.83			
Actual Adoption (AA)	AA1	0.80	0.81	0.88	0.64
	AA2	0.83			
	AA3	0.78			

Table 4 presents the results of the Fornell Larcker discriminant validity assessment. The diagonal values, representing the square roots of AVE, are higher than the corresponding inter-construct correlations in all cases. These findings confirm satisfactory discriminant validity, indicating that each latent construct captures a unique phenomenon and is sufficiently distinct from the other constructs included in the model.

Table 4. Discriminant validity (Fornell-Larcker).

Construct	PU	PEI	IS	SEC	PCR	AI	AA
PU	0.81						
PEI	0.52	0.79					
IS	0.48	0.55	0.78				
SEC	0.45	0.50	0.47	0.77			
PCR	−0.32	−0.28	−0.30	−0.25	0.82		
AI	0.60	0.58	0.52	0.49	−0.40	0.83	
AA	0.55	0.50	0.48	0.46	−0.35	0.62	0.80

4.4. Paludiculture Adoption Rate and Gradual Adoption Character

A significant number of the respondents fall into the categories of non-adopters and partial adopters, with few fully embracing paludiculture. This trend indicates that the adoption of paludiculture is generally a slow process such as beginning with one adaptive wetland crop or modifying specific water management strategies as a means of risk mitigation. This gradual approach is understandable, as paludiculture requires comprehensive changes in water management practices, crop choices, and labor and input arrangements.

4.4.1. Perception of Climate Benefits and Risks as Key Factors in Adoption Intention

The Perceived Usefulness (PU) of paludiculture had the most substantial influence on farmers' intentions to adopt ($\beta = 0.34$; $p < 0.01$). This suggests that the more farmers trust in the economic and environmental advantages of paludiculture, the more likely they are to consider adopting it. Conversely, the Perception of Climate Risk (PCR) had a significant negative impact on adoption intention ($\beta = -0.23$; $p < 0.05$), indicating that farmers concerned about risks like fires, droughts, and floods are inclined to postpone the adoption of new systems seen as potentially risky. These findings confirm the perceived risk theory regarding agricultural technology adoption, showing that uncertainties regarding outcomes and environmental conditions pose significant mental barriers, despite an awareness of the benefits that innovations can offer [40].

4.4.2. Perception of Ease of Implementation and Institutional Support

The Perceived Ease of Implementation (PEI) positively and significantly influenced adoption intention ($\beta = 0.26$; $p < 0.05$). Farmers who view paludiculture as easy to implement (for example, regarding water management, inputs, and adjustments in labor) are more likely to be motivated to adopt it [4]. This element also highlights the success of training and advisory programs that help alleviate technical concerns. Institutional Support (IS) positively impacted adoption ($\beta = 0.17$; $p < 0.10$), though with weaker significance. This indicates that the availability of programs, mentoring, and training resources can enhance adoption intentions, yet the impact remains limited as it does not reach all areas equally. Institutional support continues to be vital in reducing learning costs and boosting farmers' confidence in adopting new practices [41,42].

4.4.3. Socio-Economic Capacity of Farmers

Socioeconomic Capacity (SEC) positively influenced adoption intentions ($\beta = 0.19$; $p \approx 0.10$), showing that farmers who had more education, capital, and experience were more likely to plan to adopt new practices [43,44]. Nonetheless, the impact of SEC is less significant compared to that of Perceived Usefulness (PU) and Perceived Ease of Implementation (PEI), indicating that differences in socioeconomic status among farmers are not the sole factors influencing their decisions; factors related to institutions and perceptions are more influential [45,46].

4.4.4. The Correlation between Adoption Intentions and Actual Implementation

A strong and significant relationship was observed between adoption intentions (AI) and actual implementation (AA) ($\beta = 0.48$; $p < 0.01$). The model accounted for 56% of the variation in adoption intentions ($R^2 = 0.56$) and 38% of the variation in actual implementation ($R^2 = 0.38$). This indicates that shifts in adoption practices are mainly driven by changes in attitudes and beliefs, but actual implementation still depends on the availability of external resources and a supportive environment [47,48]. This aligns with the Theory of Planned Behavior, which states that intention is a strong predictor of actual behavior, but that behavior can only occur when external conditions are favorable [49–51].

4.5. Implications for Policy and Lessons for Implementation

The findings from this research offer three important insights for advancing paludiculture in peatland regions:

1. The reliability of economic advantages must be reinforced. Farmers require concrete proof (through demonstration plots or pilot projects) that paludiculture can enhance income and stabilize yields, rather than solely providing environmental protection.
2. Institutional backing and inclusive financing are essential. Local authorities, BRGM, and financial organizations should improve training, support, and access to microloans to decrease perceived risks and lower early adoption expenses.
3. Enhancing market access and the value chain of paludiculture is crucial. Products like purun, kelakai, and swampfish must have reliable market access to ensure farmers progress beyond just the "trial" phase.

By following this approach, paludiculture can develop into a climate-resilient agricultural model that not only sustains the functions of peat ecosystems but also enhances the well-being of local communities.

4.6. Research Limitations

This study has several limitations that should be acknowledged.

First, the research uses a cross-sectional survey design, which limits the ability to infer causal relationships between variables. The findings therefore reflect associations rather than definitive causal effects.

Second, the study relies on self-reported data collected through questionnaires, which may introduce response bias.

Third, the geographic scope of the study is limited to several sub-districts in Ogan Komering Ilir Regency. Consequently, the findings may not fully represent peatland farming communities in other regions of Indonesia.

Finally, although the sample size is adequate for PLS-SEM analysis, future research with larger samples and longitudinal data could provide deeper insights into the dynamics of paludiculture adoption over time.

5. Conclusions

This research verifies that the implementation of paludiculture in peatlands is a multifaceted socio-economic endeavor, shaped by an interplay of factors related to perception, institutional backing, household capabilities, and the understanding of climate risks. The analysis results indicated that the perceived benefits and institutional backing had the greatest impact on the willingness to adopt, while the understanding of climate risks negatively influenced this willingness, serving as a significant barrier. The intent to adopt has been shown to be a strong indicator of actual adoption behavior, although it still necessitates resource and market support for sustainable realization.

The results offer three key insights for enhancing climate-resilient agricultural practices in peatlands. First, it is crucial to boost the credibility of economic advantages through practical demonstration plots and training grounded in actual outcomes. Second, it's essential to enhance institutional support, focusing on the roles of extension agents, farmer collectives, and financial organizations, to alleviate the perceived risks and expenses associated with the transition. Third, policies promoting paludiculture must align with value chain and market strategies to furnish sustainable economic incentives for farmers.

Through a cooperative and evidence-driven approach, paludiculture holds significant promise to serve as a model of sustainable agriculture that not only preserves peat ecosystems but also enhances the economic resilience of farmers in the face of climate change.

Author Contributions

E.P. conceived and designed the research framework, supervised the overall study, and contributed to manuscript writing and revision. L.H. contributed to data collection, field survey coordination, and preliminary data analysis. G. assisted in statistical analysis using PLS-SEM and contributed to interpretation of the results. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Institutional Review Board Statement

The study was conducted in accordance with ethical standards for research involving human participants. The study protocol was reviewed and approved by the Research Ethics Committee of Universitas Baturaja, Indonesia (Reference Number: REC/UB/2026/001; approval date: April 23, 2026).

Informed Consent Statement

Participation in the survey was voluntary, informed consent (Consent to Participate and Consent to Publish) was obtained from all participants prior to the interviews, and the confidentiality and anonymity of participants were maintained throughout the study.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgments

The authors would like to express their sincere gratitude to the farming communities in Ogan Komering Ilir Regency for their active participation and valuable contributions during the field survey. We also gratefully acknowledge the support of local agricultural extension officers for their assistance in facilitating data collection. The authors further appreciate the institutional support provided by Universitas Baturaja, which made this research possible.

Conflicts of Interest

The authors declare no conflict of interest.

AI Use Statement

During the preparation of this work, the authors used ChatGPT (OpenAI) for language editing, translation assistance, and improving the clarity of academic writing. The authors subsequently reviewed and edited the content as necessary and take full responsibility for the final content of the published article.

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