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Determinants of regenerative agriculture adoption among farmers in Subak Uma Lambing, Bali, Indonesia

Ida Ayu Gede Widyasari

Graduate Program in Agribusiness, Faculty of Agriculture, Udayana University, Denpasar, Indonesia

Corresponding Email: idaayugdwydyasari@gmail.com

I Made Sudarma

Graduate Program in Agribusiness, Faculty of Agriculture, Udayana University, Denpasar, Indonesia

I Gede Setiawan Adi Putra

Graduate Program in Agribusiness, Faculty of Agriculture, Udayana University, Denpasar, Indonesia

Abstract--The transition toward regenerative agriculture requires an understanding of the factors that shape farmers' willingness to adopt farming practices that differ from established conventional systems. This study examines the economic, environmental, socio-cultural, market, and institutional factors influencing farmers' intention to adopt regenerative agriculture in Subak Uma Lambing, Bali, Indonesia, while also assessing the moderating role of institutional support. A quantitative approach was employed using survey data collected from 50 non-adopter farmers, supplemented by information from regenerative agriculture adopters. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The structural model explained 71.8% of the variance in farmers' adoption intention. The results show that socio-cultural factors had the strongest positive and significant effect on adoption intention ($\beta = 0.377$, $p = 0.009$), followed by institutional factors ($\beta = 0.364$, $p = 0.008$). In contrast, economic, environmental, and market factors did not significantly influence farmers' intention. Institutional support also did not significantly moderate the relationships between these factors and adoption intention. The findings indicate that farmers' willingness to adopt regenerative agriculture is shaped more strongly by social, cultural, and institutional conditions than by economic



incentives, environmental awareness, or market opportunities alone. Family support, cultural compatibility, access to information, training, and continuous institutional assistance are therefore critical for encouraging the transition toward regenerative farming. The study highlights the importance of culturally embedded and institutionally supported strategies for promoting regenerative agriculture within the traditional Balinese Subak system.

Keywords---regenerative agriculture, adoption intention, socio-cultural factors, institutional support, farmers, Subak, Bali.

Introduction

The sustainability of agricultural production in Indonesia remains challenged by the long-term dependence on chemical-based agricultural inputs. Although the Green Revolution contributed substantially to agricultural modernization and food production, the continued and, in some cases, excessive use of chemical fertilizers and pesticides has adversely affected soil quality and agricultural ecosystems. Declining land productivity may ultimately reduce crop yields and weaken the capacity of domestic agriculture to meet food demand. BPS (2025) reported that Indonesia imported approximately 4.52 million tonnes of rice, illustrating the continuing challenge of domestic food supply. Prolonged dependence on rice imports may have broader implications for national food security, the agricultural economy, and the welfare of local rice farmers (Kusumastuti et al., 2024). These concerns have increased the need for agricultural practices that can maintain productivity while restoring environmental quality (Evizal et al., 2024).

Environmentally sustainable agricultural approaches have consequently received increasing attention. Organic agriculture, for example, emphasizes the avoidance of synthetic chemical inputs while incorporating social, economic, and environmental considerations into agricultural production (Sapbamrer & Thammachai, 2021). Regenerative agriculture extends this orientation by emphasizing not only the use of natural inputs but also the restoration of ecological processes through improved soil structure, biodiversity, and natural nutrient cycling (Rompon et al., 2025). Its potential benefits include improved soil fertility, greater ecosystem resilience, enhanced climate resilience, and more efficient use of agricultural resources. Although transition to regenerative practices may involve additional initial costs, these costs may be offset over time through more stable yields, reduced input expenditure, and opportunities to obtain premium prices for higher-quality agricultural products (Gilchrist, 2021).

Despite these potential benefits, the transition from conventional farming to environmentally sustainable practices remains challenging. Farmers may encounter higher initial production costs, temporary productivity reductions during the transition from chemical to natural inputs, limited market access, certification constraints, and socio-cultural barriers to adopting unfamiliar practices. Consequently, the adoption of regenerative agriculture cannot be understood solely in terms of its technical or ecological advantages. Farmers'

decisions are also shaped by economic conditions, environmental considerations, socio-cultural circumstances, and market opportunities.

Bali provides a particularly relevant context for examining this transition. The provincial government has promoted environmentally friendly agriculture through Bali Provincial Regulation No. 8 of 2019 concerning Organic Agriculture Systems, followed by Bali Governor Regulation No. 15 of 2021 concerning its implementation. These policies encourage farmers to shift from chemical-based conventional agriculture toward more environmentally sustainable production systems. The initial response was reflected in an increase in organic rice production from 1,332.52 tonnes in 2019 to 1,949.46 tonnes in 2020. However, production subsequently declined to 1,503.49 tonnes in 2021 and 1,364.66 tonnes in 2022 (AOI, 2023). This fluctuation suggests that policy support alone may not necessarily ensure the sustained adoption of alternative agricultural practices.

The sustainability of such practices may therefore depend not only on farming techniques but also on institutional support and continuous assistance. In Bali, agricultural activities are closely associated with the *Subak*, a traditional local institution that organizes farmers and manages irrigation within agricultural areas. One of the communities currently implementing regenerative agriculture is Subak Uma Lambing in Abiansemal District, Badung Regency. The program is implemented in collaboration with Astungkaraway, an organization engaged in environmental sustainability, agriculture, and local community empowerment. Through this collaboration, farmers receive technical training, agricultural inputs, post-harvest facilitation, and access to marketing networks, including connections with the hospitality industry. During the initial implementation of the program, advance payments for regenerative rice harvests and agricultural input assistance were also introduced to reduce farmers' financial risks during the transition.

Such support is particularly relevant because economic constraints can substantially affect farmers' willingness to adopt new agricultural practices. Higher perceived adoption costs tend to reduce farmers' likelihood of adopting agricultural innovations (Kuswanto & Pangabea, 2025), while unstable farm income and limited initial capital may further restrict farmers' ability to invest in new production practices (Simamora et al., 2025). Technical and non-technical assistance may help overcome these constraints; however, the availability of such support has not resulted in widespread adoption among farmers in Subak Uma Lambing.

Of approximately the total membership of Subak Uma Lambing, only 25 farmers, or around 10%, have shifted to regenerative agriculture, while approximately 90% have not adopted the practice. This relatively low adoption rate is notable given the availability of institutional assistance, agricultural inputs, technical support, market facilitation, and local government involvement. The discrepancy between the support available and the actual level of farmer participation indicates that the determinants of regenerative agriculture adoption in this community remain insufficiently understood. Therefore, this study aims to examine the economic,

environmental, socio-cultural, and market factors influencing farmers' adoption of regenerative agriculture in Subak Uma Lambing, Bali, Indonesia.

Methods

This study employed a quantitative research design to examine factors associated with farmers' intention to adopt regenerative agriculture in Subak Uma Lambing, Abiansema District, Badung Regency, Bali. Data were collected in May 2026 through field surveys using structured questionnaires measured on a five-point Likert scale. The study population comprised 256 members of Subak Uma Lambing, including both adopters and non-adopters of regenerative agriculture. For the main quantitative analysis, eligible non-adopter farmers were identified purposively and subsequently selected randomly, resulting in a sample of 50 respondents based on the minimum sample requirement for Partial Least Squares Structural Equation Modeling (PLS-SEM). In addition, approximately 25 farmers who had previously adopted regenerative agriculture through the Astungkara way program were included as supporting respondents and analyzed descriptively to provide complementary perspectives on actual adoption experiences.

The research model consisted of four main exogenous constructs—economic factors, environmental factors, socio-cultural factors, and market factors—and farmers' intention to adopt regenerative agriculture as the endogenous construct. Institutional factors were examined both as a direct predictor of adoption intention and as a moderator of the relationships between the four exogenous constructs and farmers' intention. Primary data were analyzed using PLS-SEM to evaluate the measurement and structural models, including construct reliability and validity, collinearity, path coefficients, coefficient of determination (R^2), effect sizes, and the significance of the hypothesized relationships. Descriptive analysis was additionally used to summarize respondent characteristics and supporting information obtained from regenerative agriculture adopters.

Result and Discussion

The measurement model was assessed before examining the structural relationships. Indicators with outer loadings below the recommended threshold were removed, after which all retained indicators showed satisfactory loadings. The final constructs also met the requirements for convergent validity and internal consistency, with average variance extracted (AVE) values ranging from 0.562 to 0.914 and composite reliability values ranging from 0.794 to 0.977. Discriminant validity was also established, indicating that the constructs measured conceptually distinct dimensions of farmers' perceptions. Overall, the final measurement model was considered adequate for evaluating the structural relationships.

The structural model explained a substantial proportion of farmers' intention to adopt regenerative agriculture, with an (R^2) value of 0.718. Thus, approximately 71.8% of the variance in adoption intention was explained by the economic, environmental, socio-cultural, market, and institutional factors included in the model. The model also demonstrated predictive relevance ($(Q^2=0.617)$). The results of the structural model are summarized in Table 1.

Table 1. Structural model results

Relationship	β	t-value	p-value	Result
Economic factors → Adoption intention	0.150	1.409	0.159	Not significant
Environmental factors → Adoption intention	0.106	0.878	0.380	Not significant
Socio-cultural factors → Adoption intention	0.377	2.609	0.009	Significant
Market factors → Adoption intention	0.065	0.472	0.637	Not significant
Institutional factors → Adoption intention	0.364	2.662	0.008	Significant
Institutional × Economic → Adoption intention	0.037	0.363	0.717	Not significant
Institutional × Environmental → Adoption intention	0.081	0.750	0.454	Not significant
Institutional × Socio-cultural → Adoption intention	-0.077	0.605	0.545	Not significant
Institutional × Market → Adoption intention	-0.052	0.430	0.667	Not significant
Primary Data, 2026				

Determinants of Farmers' Intention to Adopt Regenerative Agriculture

Among the factors examined, socio-cultural factors had the strongest positive influence on farmers' intention to adopt regenerative agriculture ($\beta=0.377$), ($p=0.009$), with a moderate effect size ($f^2=0.230$). Following measurement model evaluation, this construct was represented primarily by cultural compatibility and family support, with family support showing the stronger contribution. This finding suggests that farmers' willingness to shift toward regenerative agriculture is closely related to whether the practice is compatible with their existing cultural values and whether sufficient support is available within the household.

Family support is particularly important because the transition to regenerative agriculture may require additional time, labor, and involvement in activities such as preparing organic inputs and maintaining crops. Previous research has similarly identified time and labor requirements as important constraints in transitions toward regenerative farming systems (Alexanderson et al., 2024). In Subak Uma Lambing, family members may therefore contribute not only psychological encouragement but also labor needed during the transition. This result is consistent with Li et al. (2023), who found that family support can influence farmers' intention to adopt agricultural innovations, while Fortuna et al. (2025) emphasized the relevance of cultural compatibility in shaping farmers' confidence in adopting farming practices.

In contrast, economic factors did not significantly influence adoption intention ($\beta=0.150$), ($p=0.159$). Although regenerative agriculture may provide long-term productivity and profitability benefits (Muleke et al., 2026), these potential gains have not yet become sufficiently compelling for non-adopter farmers in Subak Uma Lambing. Field observations indicated that many conventional farmers preferred commodities that generate more immediate income, particularly

flowers, rather than waiting for the relatively longer production cycle of rice. This finding differs from studies suggesting that economic considerations constitute an important determinant of environmentally friendly farming adoption (Munguia, 2021; Lemke, 2023). The difference indicates that farmers may evaluate economic benefits not only in terms of potential profitability but also in terms of the timing and certainty of income.

Environmental factors were also not significantly associated with adoption intention ($\beta = 0.106$, $p = 0.380$). Farmers generally recognized the deterioration of soil and water conditions but continued to perceive chemical inputs as necessary for maintaining production. Environmental awareness therefore did not automatically translate into a willingness to change farming practices. This differs from Savari et al. (2023), who reported a positive relationship between environmental awareness and farmers' intention to adopt environmentally friendly practices, but is more consistent with Drescher et al. (2024), who found that perceived environmental benefits may have a relatively limited effect on adoption when farmers face practical implementation constraints.

Similarly, market factors had no significant effect on adoption intention ($\beta = 0.065$, $p = 0.637$). Although regenerative products may offer premium prices and alternative marketing opportunities, non-adopter farmers had not yet experienced clear market advantages over conventional products. Conventional harvests could still be sold through established intermediaries without substantial difficulty. Consequently, price premiums, consumer demand, and alternative marketing networks remained relatively abstract benefits for farmers who had not yet entered the regenerative supply chain. This finding contrasts with Ume (2023), who identified market access as an important driver of environmentally friendly agricultural adoption. In the present context, established marketing practices appear to reduce the perceived urgency of seeking alternative markets.

Institutional Support and Its Moderating Role

Institutional factors had a positive and significant direct effect on farmers' adoption intention ($\beta = 0.364$, $p = 0.008$), with a moderate effect size ($f^2 = 0.206$). Institutional support was represented by extension and training, institutional assistance, supportive regulations, and access to innovation-related information. Among these dimensions, access to information showed the strongest contribution, indicating that farmers particularly value timely and reliable information that reduces uncertainty surrounding new farming practices.

This finding highlights the importance of institutions not merely as providers of financial assistance but also as sources of knowledge, technical guidance, market information, and continued support. Training and extension activities can improve farmers' knowledge and perceptions of environmentally sustainable practices (Grimm & Luck, 2023), while demonstrations and direct knowledge transfer can facilitate farmers' understanding and acceptance of agricultural innovations (Ntawuhiganayo et al., 2023). The experience in Subak Uma Lambing further suggests that institutional functions may be distributed across several actors. Although some farmers expressed reduced trust in Subak management, assistance provided by other actors, particularly Astungkaraway, continued to

support training, technical assistance, information, and market facilitation. This supports Tanti et al. (2022), who emphasized that the broader functions performed by agricultural institutions can facilitate innovation adoption.

However, institutional factors did not significantly moderate the effects of economic, environmental, socio-cultural, or market factors on farmers' intention. This indicates that institutional support operates primarily as a direct determinant of adoption intention rather than as a mechanism that changes the influence of other factors. In particular, the strong socio-cultural influence appears to arise from relatively internal conditions such as family support and established cultural values, which may not be easily strengthened through external institutional intervention. Likewise, institutional assistance did not substantially change farmers' perceptions of environmental benefits or market opportunities when these advantages had not yet been directly experienced.

Taken together, these findings indicate that the transition toward regenerative agriculture in Subak Uma Lambing is shaped more strongly by social embeddedness and institutional support than by economic, environmental, or market considerations alone. Increasing adoption may therefore require strategies that combine continuous institutional assistance with approaches that are compatible with local cultural values and household conditions. Rather than relying solely on economic incentives or environmental messaging, extension programs could involve family members, incorporate locally relevant cultural values, and provide tangible demonstrations of the economic and market outcomes achieved by existing regenerative farmers.

Conclusion

This study examined the factors influencing farmers' intention to adopt regenerative agriculture in Subak Uma Lambing, Bali, by considering economic, environmental, socio-cultural, market, and institutional factors. The findings demonstrate that farmers' adoption intention is primarily shaped by socio-cultural and institutional factors, while economic, environmental, and market factors do not exert significant direct effects. Among the significant predictors, socio-cultural factors emerged as the strongest determinant, particularly through cultural compatibility and family support. Institutional support also plays an important role through training, technical assistance, supportive policies, and access to relevant information. These findings indicate that farmers' willingness to transition toward regenerative agriculture is not determined solely by perceptions of economic returns, environmental benefits, or market opportunities, but is strongly embedded in their social, cultural, and institutional context.

Institutional factors were found to have a significant direct effect on adoption intention but did not significantly moderate the relationships between economic, environmental, socio-cultural, and market factors and farmers' intention. This suggests that institutional interventions are more effective when they directly reduce uncertainty, provide knowledge, and support farmers during the transition rather than merely attempting to strengthen other perceived benefits of regenerative agriculture. Accordingly, efforts to expand regenerative agriculture in Subak Uma Lambing should prioritize culturally appropriate and socially

embedded approaches, including family involvement, continuous extension and mentoring, improved access to reliable information, and stronger coordination among Subak, agricultural extension services, local government, and supporting organizations. Demonstrating tangible economic and market outcomes from existing regenerative farms may also help farmers evaluate benefits that have not yet been directly experienced. Future studies should examine whether these intentions translate into actual and sustained adoption over time and assess the findings across different Subak communities to provide a broader understanding of regenerative agriculture transitions in Bali.

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