Internal Drivers of Sustainable Agricultural Adaptation in the Subak Sembung Ecotourism Area, Bali

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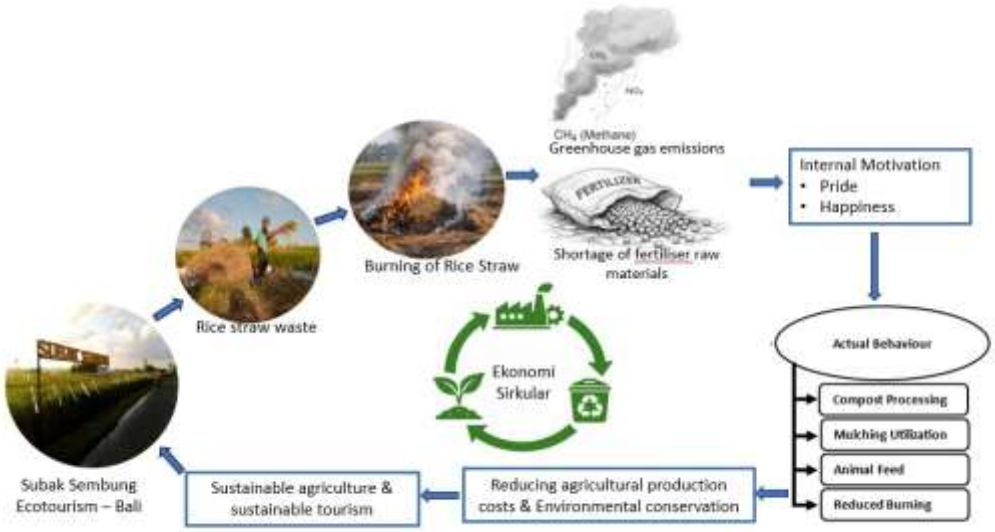
Abstract
This study analyses the internal factors driving the adoption of sustainable, zero-waste agriculture in the Subak Sembung ecotourism area, Denpasar, Bali. Subak Sembung, as one of the city's green zones that serves a dual function as both agricultural land and an ecotourism destination, faces a dilemma between environmental aesthetic demands and farmers' conventional practices, particularly the burning of rice straw. This study employs a quantitative approach using a cross-sectoral survey of 124 respondents, alongside SEM-PLS analysis to examine the relationship between internal motivations (pride and happiness), intention, and actual behaviour in agricultural waste management. The results indicate that internal motivation has a significant influence on intention (coefficient 0.68; t = 8.45) and actual behaviour (coefficient 0.41; t = 2.87), with intention acting as a strong mediator explaining 58% of the variance in adaptive behaviour. Although straw burning remains the dominant practice (32%), there is a growing trend towards the adoption of environmentally friendly methods such as composting (28%) and mulching (24%), particularly among farmers of working age, those with a secondary education or higher, and private landowners. Theoretically, these findings expand the literature on the circular economy by emphasising the role of internal psychological factors in the adoption of agricultural innovations, moving beyond a purely rational economic perspective. In practical terms, the research results have policy implications suggesting that sustainability interventions should be directed towards strengthening farmers' intrinsic motivation and collective intent through education, extension services, incentives, and institutional support from the Subak.

Keywords: Internal motivation, Subak Sembung, Sustainable agriculture,

Introduction

The transition to a circular economy and zero waste is positioned as a key strategy for achieving the SDGs and climate targets for 2030–2050 (Pandey et al., 2025; Rabbi & Amin, 2024). The circular economy is defined as a model that reduces the use of primary resources and waste, maintaining the value of materials as high as possible through cycles of reuse, recycling, and energy recovery (Hamam et al., 2021; Pandey et al., 2025). Open-field burning of rice straw in the agricultural sector remains the dominant method in many rice-producing regions of developing countries because it is cheap, quick, and suits very short cropping intervals (Parihar et al., 2023). Field burning of straw can release up to approximately 7.3 tonnes of CO_2-eq ha^{-1} (Bhattacharyya et al., 2021). This phenomenon is also evident in stark contrast within the Subak Sembung Ecotourism Area, Denpasar, Bali. As one of the last 'green lungs' amidst the rapid urbanisation of Denpasar City, Subak Sembung faces a major dilemma. On the one hand, the area is required to maintain its aesthetic appeal and environmental sustainability for the sake of its ecotourism function; on the other hand, farmers remain trapped in conventional methods of managing agricultural waste that are neither economically nor ecologically optimal.



Although the government and various institutions have introduced zero-waste innovations—such as processing straw into compost or animal feed—the level of adoption among farmers in Subak Sembung presents an anomaly. As an ecotourism area, access to information and institutional support in this region is relatively higher than in purely agricultural areas. However, field data indicate that the availability of technology and policy guidance does not automatically lead to a massive shift in farmers' behaviour. A study in Punjab, India, revealed that the main barrier to moving away from straw burning is not cost, but rather the difficulty in accessing equipment and government subsidies, even though these alternative technologies are far more economical (Bhatt et al., 2022).

Academically, the literature on the adoption of agricultural innovations remains largely dominated by rational economic perspectives and external technical barriers. Many studies focus on how financial incentives or land area influence technology adoption. However, there remains a research gap in the literature regarding the exploration of internal psychological dimensions—such as intrinsic motivation, pride, and subjective well-being—in the context of farmers working in the interface between agriculture and tourism (ecotourism).

This study argues that in ecotourism areas such as Subak Sembung, the adoption of sustainable agricultural practices is not merely a technical decision, but rather a manifestation of inner satisfaction and the perception of added value for the environment. A study in Europe shows that general attitudes, intentions, and perceptions of utility have a far stronger influence on the adoption of sustainable practices than economic outcomes or mere cognitive environmental awareness (Swart et al., 2023). A qualitative study on regenerative agriculture in the US found that the primary drivers of adoption were a desire to improve human, soil, and ecosystem health, as well as a moral shift away from industrial agriculture; many practitioners interpret these practices as a calling of values and a way of life, rather than merely a technological choice (Frankel-Goldwater et al., 2024).

This study aims to analyse the influence of internal factors on farmers' level of adaptation to zero-waste-based agricultural waste management. By focusing on Subak Sembung, this study is expected to provide a theoretical contribution regarding the importance of psychological aspects in the success of the circular economy in urban agricultural land. In practical terms, the findings of this study will serve as a guide for ecotourism managers and policymakers in Denpasar in designing more humane and sustainable intervention strategies for the Subak farming community. This research is all the more important given that Subak is a UNESCO World Heritage system.

MATERIALS AND METHODS

Research Design and Location

This study employs a quantitative design using a cross-sectional survey approach. Quantitative research emphasises numerical measurement, hypothesis testing, and statistical analysis (regression, correlation, and t-tests) to answer research questions objectively (Lim, 2025; Nwabuko et al., 2024). Meanwhile, a cross-sectional survey means that data is collected once at a single point in time for each respondent; researchers measure 'exposure' (e.g., attitudes, characteristics, contextual factors) and 'outcome' simultaneously (Zuleika & Legiran, 2022). Non-experimental observational designs fall within the evidence hierarchy below cohort and experimental trials but are widely used due to their cost and time efficiency (Slater & Hasson, 2025).

The research location was selected through purposive sampling in the Subak Sembung Ecotourism Area, Denpasar, Bali. This choice of location was based on the unique characteristics of Subak Sembung as an urban green zone that integrates agricultural production with ecotourism services based on UNESCO cultural heritage.

Population and Sample

The population in this study comprised all active farmers in the Subak Sembung area, totalling 179 people. To obtain a representative sample with a 95% confidence level (5% margin of error), the sample size was determined using the Slovin formula as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Description

n = sample size

N = population size (179 people)

e = error tolerance level

The calculation is therefore as follows:

$n = \frac{179}{1+179(0.05)^2} = \frac{179}{1+179(0.0025}$

$n = \frac{179}{1+0.4475} = \frac{179}{1.4475} = 123.66$

If rounded up, the required sample size is 124 respondents

Data Collection and Analysis Procedures

Data collection was carried out through face-to-face interviews using a questionnaire to ensure that respondents understood the technical terminology relating to the circular economy. The measurement instrument used a 1–5 Likert scale (Strongly disagree to Strongly agree).

The questionnaire instrument used is valid, as the majority of indicators have factor loadings above 0.70 and average variance extracted (AVE) values in the range of 0.60–0.70. This indicates that indicators such as pride, happiness, intention, and actual behaviour truly represent the constructs being measured.

Reliability was also well established, as demonstrated by Cronbach's Alpha values of approximately 0.78–0.82 and Composite Reliability (CR) values of approximately 0.80–0.85, all of which exceeded the minimum threshold

of 0.70. This indicates that respondents' answers were consistent and stable in measuring aspects of motivation, intention, and actual adaptive behaviour.
The data collected were analysed using descriptive analysis to map the socio-demographic profiles of the respondents (age, education, land area, and ownership status). Subsequently, SEM-PLS analysis was used to examine the relationship between internal motivation (pride and happiness) and farmers' intentions and actual adaptation behaviours regarding the management of rice straw waste.

Results

Respondent Characteristics

Around 40% of respondents were aged 31–40, and 30% were aged 41–50, indicating that the working-age generation dominates agricultural activities. The over-50 age group was small (15%), but significant, as it represents senior farmers with extensive experience. Secondary education (SMA) was the most common level, suggesting that the majority of farmers have had sufficient access to formal education. However, 45% of respondents had only completed primary or lower secondary education (SD/SMP), indicating limited formal literacy among farmers.
In terms of farming experience, the majority (45%) have intermediate experience (11–20 years), indicating well-established skills. There are also senior farmers with over 20 years' experience (25%) and beginners with less than 5 years' experience (10%). In terms of land ownership, the majority of farmers (55%) own their own land, which provides stability for their farming operations. The remaining 45% rely on a lease or sharecropping system, indicating unequal access to productive assets. Most farmers manage small plots (≤50 are), reflecting a subsistence or semi-commercial farming pattern, whilst only 15% own land exceeding 1 hectare, typically privately owned.

Management of Rice Straw Waste

Based on the distribution chart for rice straw waste management, it is evident that the burning method still dominates, accounting for 32%, followed by composting (28%), mulching (24%), and the two least-used methods, namely burial (8%) and use as animal feed (8%) (Figure 1). This pattern indicates that although some farmers have adopted environmentally friendly practices, traditional practices such as burning remain quite prevalent in the field, particularly among farmers with limited access to technology and information.

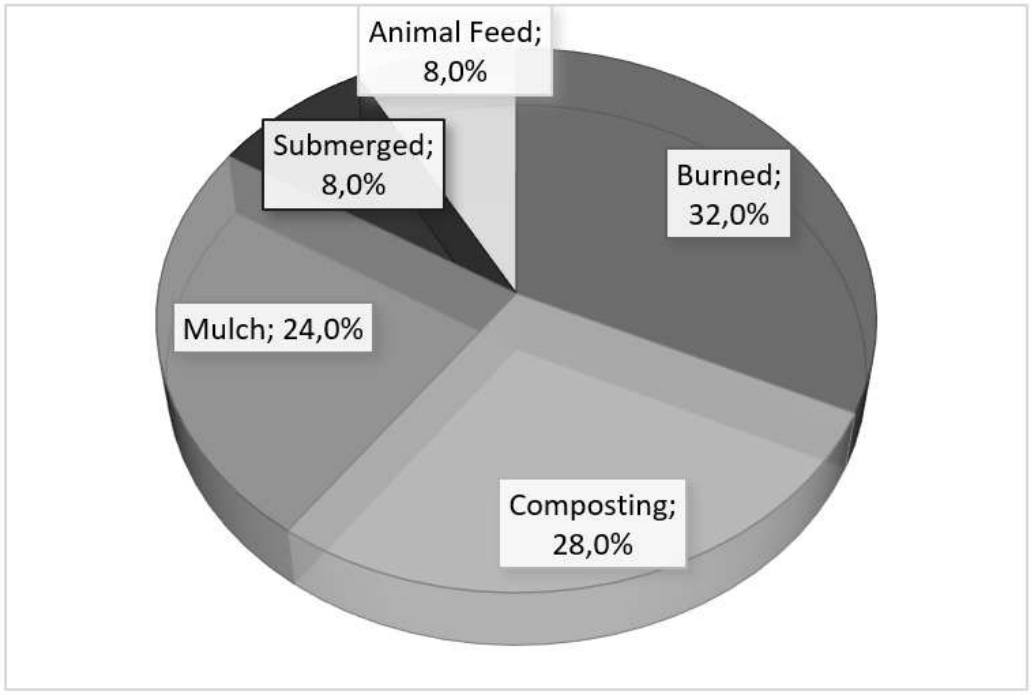


Figure 1. Distribution of rice straw processing methods in Subak Sembung

When considered in conjunction with the questionnaire results, the choice of processing method is strongly influenced by internal drivers of sustainable agricultural adaptation, such as pride, happiness, and the intention to continue zero-waste practices. Farmers who opt for composting and mulching generally possess high levels of internal motivation, have completed secondary education or higher, and own their land outright, which encourages them to invest in sustainable practices. Conversely, farmers who choose burning (Figure 2) tend to be older, less educated, and own small plots of land on a lease or sharecropping basis, which makes them more pragmatic and less inclined to innovate.

Figure 2. Burn marks from the burning of rice straw

Meanwhile, the fact that farmers with technical knowledge or access to livestock chose the composting method and animal feed suggests that sustainable adaptation is also influenced by the local economic and ecosystem context. Consequently, the success of implementing a zero-waste approach in Subak Sembung depends heavily on strengthening internal motivation and structural support that enable farmers to transition to more environmentally friendly practices.

SEM-PLS Analysis: The Role of Intrinsic Motivation and Intention in Promoting Sustainable Adaptive Behaviour Among Farmers

The SEM-PLS analysis indicates that the Internal Motivation construct (pride and happiness) has an AVE of 0.65 and a CR of 0.83, indicating good validity and reliability. The path from Internal Motivation to Intention (H1) yielded a coefficient of 0.68* with a t-value of 8.45, significant at the 0.001 level. The Intentions construct (plans to continue the programme and belief in benefits) has an AVE of 0.63 and a CR of 0.81, with $R^2 = 0.46$, indicating that internal motivation explains 46% of the variance in intentions.

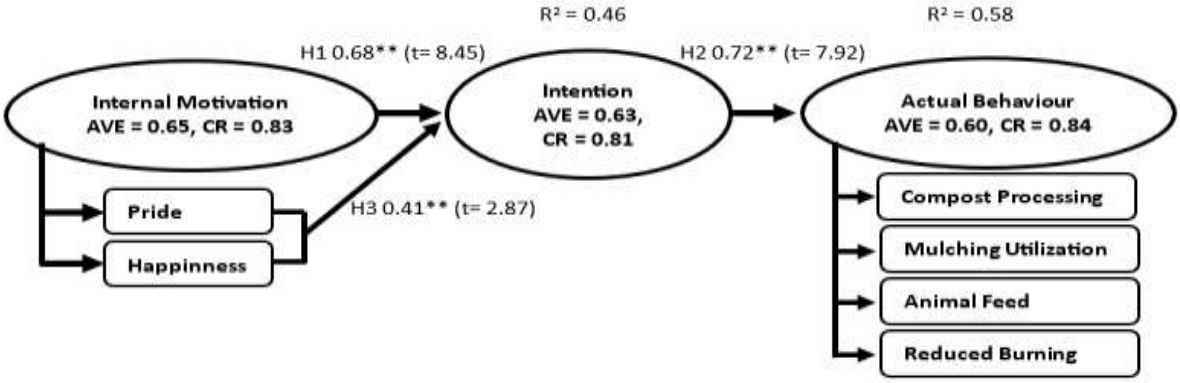


Figure 3. SEM-PLS Model of Farmers' Internal Motivation, Intention and Actual Behaviour

Furthermore, the path from Intention to Actual Behaviour (H2) yielded a coefficient of 0.72* with a t-value of 7.92, significant at the 0.001 level. Actual Behaviour (compost, mulch, livestock feed, reduction in burning) has an AVE = 0.60 and CR = 0.84, with $R^2 = 0.58$, meaning that intention and internal motivation together explain 58% of the variance in adaptive behaviour. The direct path from Internal Motivation to Actual Behaviour (H3) is also significant, with a coefficient of 0.41 and t = 2.87, although weaker than the mediating path via intention.

Discussion

Farmers in Subak Sembung are predominantly of working age with moderate to extensive farming experience, giving them both the energy to innovate and a strong grounding in local knowledge. A study in Gorontalo showed that younger farmers (aged 25–45) tend to be more oriented towards product innovation, the integration of annual crops for short-term income, and the adoption of external technologies (e.g., virgin coconut oil, innovative processed products, digital marketing) compared to older farmers who focus on the long-term revitalisation of crops (Tolinggi et al., 2023). In general, younger farmers are more risk-tolerant, more likely to take out loans and adopt new technologies, and tend to implement more sustainable practices (Jansuwan & Zander, 2022).

Farmers of working age are more open to innovation because they are still physically and mentally fit. They are more receptive to new technologies such as high-yield seeds, modern cropping patterns, and smart farming. A study in Germany shows that motivation, performance expectations, and technological readiness drive the use of smart products—and these factors are stronger among working-age farmers (Schukat & Heise, 2021). Extensive farming experience builds practical knowledge regarding seasons, soil, fertilisers, and the risk of crop failure. A review in Europe indicates that experience and a history of innovation adoption are key determinants of the acceptance of circular practices and environmentally friendly technologies (Herrera et al., 2023; Serebrennikov et al., 2020).

As they get older, farmers tend to be more cautious, less willing to try new things, and rarely plan to adopt new technologies (Brown et al., 2019). A meta-analysis in Ethiopia indicates that age limits technology adoption, but market access, extension services, and education can mitigate this effect (Ayalew & Girma, 2025). An ageing agricultural workforce reduces productivity by hindering technology adoption and efficiency (Tong et al., 2024).

The fact that the majority of people have a secondary education (upper secondary school) provides a sufficient foundation in literacy, although low levels of education remain a challenge in the adoption of sustainable technologies. Several studies indicate that education, extension services, and training encourage the adoption of sustainable technologies (Begho et al., 2022; Ma & Bahadur, 2024; Serebrennikov et al., 2020). A study in Kenya found that secondary education was a positive and significant predictor of the adoption of aquaculture technologies; more educated farmers were better able to access, understand, and analyse technical information, making them better prepared to adopt innovations (Obiero et al., 2019).

Whilst private land ownership in Subak Sembung is relatively dominant, the small size of the plots and the existence of a system of leasing and sharecropping mean that sustainability depends on the collective synergy of the Subak community. Research on urban subaks indicates that land area is a key determinant of the sustainability of farming enterprises. Small plots of land require increased productivity, business diversification such as agritourism, and institutional support to remain economically and ecologically viable (Wulandari et al., 2024). Conversely, land fragmentation and leasing practices without institutional support risk reducing young people's interest in farming and driving land conversion (Cahyaningtiyas et al., 2021). The literature on subak widely emphasises that social capital, customary institutions (awig-awig), and collective work are the foundations of sustainability, particularly when subak face pressures from urbanisation and tourism (Okura et al., 2022; Risna et al., 2022; Zen et al., 2024).

Specifically regarding the management of rice straw waste, survey results indicate that the most commonly used method is burning (32%), followed by composting (28%) and mulching (24%). This pattern suggests that, although traditional practices such as burning remain fairly dominant, there is a growing trend towards the adoption of environmentally friendly methods such as composting and mulching. This indicates a shift in farmers' behaviour towards more sustainable practices, although this is not yet fully optimised. Numerous studies indicate that traditional methods relying on straw burning and excessive use of chemical fertilisers are no longer considered sustainable. Consequently, environmentally friendly practices such as composting, using mulch, reducing tillage, and crop rotation are now being promoted more widely (Boros et al., 2025; Gamage et al., 2023). Global studies indicate that sustainable practices such as composting, manure application, and soil conservation are increasingly being adopted by smallholder farmers, although they have not yet become mainstream practices (Boros et al., 2025; Campos et al., 2025).

The main reason farmers in Subak Sembung burn rice straw is to prepare for the next planting season, and because they do not fully understand composting techniques. Several studies indicate that burning is perceived as a quick way to reduce weeds, pests, and crop residues, whilst saving on labour costs and tractor fuel (Kaur et al., 2022; Parihar et al., 2023; Sereenonchai & Arunrat, 2022). In a study in Subak Telun Ayah, farmers explicitly stated that they burn straw because they do not know how to compost and consider composting to be difficult, time-consuming, costly, and labour-intensive (I Nengah et al., 2022). A study on farmer empowerment in West Java confirmed that farmer characteristics (education, experience) and support from the government/extension workers, as well as the availability of information and facilities, are key determinants of the use of straw for composting (Haryanto et al., 2023).

When considering internal drivers, farmers who take pride in and enjoy environmentally friendly farming practices typically opt for better ways of managing straw, such as composting and mulching. Conversely, older farmers, those with lower levels of education, or those with limited land and access to technology, are more likely to choose burning, as it is considered practical. Research on composting/mulching and organic technologies also shows that education and training increase adoption, whilst older, less educated households with limited labour or access to technology tend to be reluctant towards practices considered complex, such as composting, and revert to the most practical methods within their context (Mebrate et al., 2022; Mwaura et al., 2021). Within a behavioural framework, pro-environmental personal norms, a sense of responsibility, and self-efficacy are key drivers. Farmers who feel capable and take pride in managing straw without burning are more likely to consistently maintain and disseminate these practices (Sereenonchai & Arunrat, 2022, 2024).

Meanwhile, the choice of mulching methods and livestock feed by farmers with technical knowledge or access to livestock indicates the influence of the local economic and ecosystem context. Consequently, strengthening internal motivation through education, extension services, and policy support is key to encouraging farmers' intentions and actual behaviour to switch to more environmentally friendly and sustainable straw waste management practices. Research on the adoption of environmentally friendly technologies indicates that farmers with positive attitudes and environmental conscience prefer soil- and health-friendly technologies, such as straw returning, composting, and reuse, over burning (Atinkut et al., 2020; Ren & Zhong, 2022; Zeng et al., 2019). Within the framework of the Theory of Planned Behaviour, pro-environmental attitudes, personal norms, and

perceived behavioural control form a strong intention to adopt technologies such as straw return. This intention is then effectively translated into action in the field, particularly when reinforced by government policy support and facilities (Jiang et al., 2022; Ren & Zhong, 2022).

The results of the SEM-PLS analysis indicate that intrinsic motivation is the primary determinant in driving farmers' intention to adopt zero-waste practices. Pride in being a farmer and the joy of practising environmentally friendly agriculture were found to enhance commitment to continuing the straw waste management programme. These findings are consistent with the theory of planned behaviour, which states that an individual will act if they have the intention to do so. Such intentions arise from three factors: self-efficacy, the influence of others, and the belief in one's ability to act (Ajzen, 2020). Meta-analyses and reviews indicate that attitude is the strongest predictor of intention regarding green behaviour, followed by subjective norms and perceived behavioural control (Dessart et al., 2019). Pride and happiness as a farmer can be understood as components of a positive affective attitude towards environmentally friendly practices, whilst also being linked to farmers' identity and self-worth (Dessart et al., 2019; Klebl et al., 2024).

In the context of farmers, reviews of the Theory of Planned Behaviour (TPB) have found that attitudes, subjective norms, and perceived behavioural control are consistently associated with the adoption of sustainable practices across various domains (biosecurity, soil conservation, etc.) (Dessart et al., 2019; Klebl et al., 2024; Sok et al., 2021). Moral responsibility and personal norms have also been shown to enhance the explanatory power of the Theory of Planned Behaviour regarding farmers' environmental behaviour (Guo et al., 2021; Sereenonchai & Arunrat, 2022). A study in China on straw utilisation based on the Theory of Planned Behaviour found that attitudes, subjective norms, perceived behavioural control, and moral responsibility increased the intention to use straw and actual behaviour; subjective norms and moral responsibility were the strongest predictors (Guo et al., 2021).

Furthermore, intention has been shown to have a strong influence on farmers' actual behaviour. A large meta-analysis of the adoption of sustainable agricultural practices in Europe found a relatively strong intention–behaviour correlation ($r \approx 0.41$) between the intention to adopt sustainable practices and actual adoption. However, moderation analyses revealed an intention–behaviour gap: motivational factors often appeared stronger when only intention was measured compared to actual behaviour (Swart et al., 2023). Research on horticultural farmers in Norway indicates that intentions do not always translate into reality. Only around one in three farmers who planned to grow cover crops actually did so. Indeed, even very strong intentions do not guarantee that they will take concrete action (Byfuglien et al., 2025).

Farmers with a strong intention are more consistent in processing straw into compost, using it as mulch or livestock feed, and reducing the practice of burning. This suggests that intention acts as a mediator bridging internal motivation with actual behaviour; therefore, policy interventions should be directed towards strengthening intention through awareness-raising, training, and incentives. Research in Jilin, China, found that behavioural willingness has a positive and significant influence on actual straw utilisation behaviour, whilst attitudes and subjective norms influence behaviour both directly and via behavioural willingness (Guo et al., 2021). A TPB study on straw return technology in China showed that attitudes, subjective norms, and perceived behavioural control (PBC) increase intention, and this intention subsequently has a significant effect on the actual behaviour of adopting straw technology; intention acts as the primary mediator between subjective cognition/internal motivation and straw return actions (Guo et al., 2021; Ren & Zhong, 2022).

The direct pathway from internal motivation to actual behaviour is also significant, although weaker than the mediating pathway. This suggests that some farmers with high motivation may act directly without going through an explicit intention process, for example, due to emotional drives or the cultural values of Subak, which emphasise harmony with nature. Theories and meta-analyses from Self-Determination Theory (SDT) confirm that autonomous (internal) motivation not only influences behaviour through cognitive mechanisms such as intention, but can also drive direct action due to a sense of control and high intrinsic energy (Howard et al., 2021; Van den Broeck et al., 2021). Other studies also indicate that self-efficacy or self-confidence often acts as a key mediator between internal motivation and behaviour, yet a direct pathway persists, particularly when individuals possess a firm readiness or resolve (Li et al., 2025).

However, the mediation pathway remains dominant, so sustainability strategies must emphasise the formation of collective intentions. The direct effect from internal motivation to actual behaviour is also significant, although weaker than the mediation pathway. Other research confirms that interventions emphasising social relevance and future-oriented thinking can strengthen collective intentions, thereby driving individual and group action more effectively than relying solely on direct internal motivation (Sinclair et al., 2025). Furthermore, self-determination theory suggests that whilst intrinsic motivation can drive direct action, behavioural sustainability is better assured if collective intentions are formed as a mediator that integrates shared values and group commitment (H. Li & Wen, 2019). In the context of organisational sustainability strategies, intellectual leadership that mediates between personal motivation and corporate strategy also highlights the importance of fostering collective intent to achieve optimal outcomes (Eide et al., 2020).

Overall, this SEM-PLS model indicates that the successful implementation of the zero-waste concept in Subak Sembung is highly dependent on the synergy between farmers' internal motivation and their intentions. With a fairly high R^2 (0.46 for intentions and 0.58 for actual behaviour), it can be concluded that internal psychological factors play a crucial role in driving sustainable adaptive behaviour. These findings make a theoretical contribution to the literature on sustainable agriculture, whilst also offering practical implications for local policy in strengthening farmers' motivation and intentions through educational programmes and community empowerment.

A large-scale meta-analysis on the adoption of sustainable agricultural practices in Europe found that general attitudes, intentions, and perceived benefits have a far stronger influence on adoption than economic

considerations or mere environmental awareness, and also revealed the existence of an intention–behaviour gap (Swart et al., 2023). Another study on the green utilisation of waste in the context of Chinese farmers also emphasised that egoistic, altruistic, and biospheric values towards the environment form internal motivation, which then, through subjective norms and PBC, generates a strong intention for pro-environmental practices (Cao et al., 2022).

The policy implications of this research emphasise that sustainability strategies in Subak Sembung must not rely solely on technology and regulations, but must also integrate the psychological, social, and cultural dimensions of farmers' lives. Local authorities and ecotourism managers need to strengthen farmers' intrinsic motivation through education that emphasises pride and happiness in environmentally friendly practices, whilst fostering a collective intent through community forums and the traditional Subak institutions. Structural support in the form of access to simple technology, subsidies, and outcome-based incentives will reinforce farmers' commitment to switching from straw burning to compost and mulch. Furthermore, the integration of ecotourism and sustainable agriculture can enhance economic value whilst reinforcing the region's image as a UNESCO World Heritage Site.

Conclusions

This study confirms that the success of sustainable agricultural adaptation in the Subak Sembung ecotourism area is highly dependent on internal factors among farmers, particularly intrinsic motivations such as pride and happiness derived from managing land in an environmentally friendly manner. SEM-PLS analysis indicates that internal motivation has a significant influence on intention, and intention acts as a strong mediator linking motivation to actual behaviour in the management of straw waste based on the zero-waste principle.

Although traditional practices such as burning remain prevalent, there is a growing trend towards the adoption of environmentally friendly methods such as composting and mulching, particularly among farmers of working age, those with a secondary education or higher, and private landowners. This indicates a shift in behaviour towards more sustainable practices, although this shift is not yet fully established.

Theoretically, these findings expand the literature on the circular economy by emphasising the role of internal psychological factors in the adoption of agricultural innovations, moving beyond a purely rational economic perspective. In practical terms, the research findings have important implications for local policy: sustainability interventions should be directed towards strengthening farmers' collective motivation and intentions through education, extension services, incentives, and institutional support from the Subak. Thus, zero-waste strategies in urban areas such as Subak Sembung depend not only on technology and regulation, but also on the affective dimensions and cultural values inherent to the farming community.

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References

1. Ajzen, I. (2020). The theory of planned behavior : Frequently asked questions. *Hum Behav & Emerg Tech*, *2*(4), 314–324. https://doi.org/https://publons.com/publon/10.1002/hbe2.195
2. Atinkut, H. B., Yan, T., Zhang, F., Qin, S., & Gai, H. (2020). Cognition of agriculture waste and payments for a circular agriculture model in Central China. *Scientific Reports*, *10*(1), 10826. https://doi.org/10.1038/s41598-020-67358-y
3. Ayalew, A., & Girma, Y. (2025). The Effect of Age on Agricultural Technology Adoption by Smallholder Farmers in Ethiopia: A Systematic Review and Meta-Analysis. *Advances in Agriculture*, *2025*(1), 8881484. https://doi.org/https://doi.org/10.1155/aia/8881484
4. Begho, T., Glenk, K., Anik, A. R., & Eory, V. (2022). A systematic review of factors that influence farmers ' adoption of sustainable crop farming practices : Lessons for sustainable nitrogen management in South Asia. *J Sustain Agric Environ*, *1*(2), 149–160. https://doi.org/https://doi.org/10.1002/sae2.12016
5. Bhatt, R., Giang, A., & Kandlikar, M. (2022). Incentivizing Alternatives to Agricultural Waste burning in Northern India : Trust , Awareness , and Access as Barriers to Adoption. *Environment Systems and Decisions*, *43*(3), 358–370. https://doi.org/https://doi.org/10.21203/rs.3.rs-1586008/v1
6. Bhattacharyya, P., Bisen, J., Bhaduri, D., Priyadarsini, S., Munda, S., Chakraborti, M., Adak, T., Kumar, S., & Nimbrayan, P. (2021). Turn the wheel fromwaste towealth: Economic and environmental gain of sustainable rice straw management practices over field burning in reference to India. *Science of the Total Environment*, *775*(2021), 145896. https://doi.org/10.1016/j.scitotenv.2021.145896
7. Boros, A., Szolik, E., Desalegn, G., & Tozser, D. (2025). A Systematic Review of Opportunities and Limitations of Innovative Practices in Sustainable Agriculture. *Agronomy*, *15*(76), 1–40. https://doi.org/https://doi.org/10.3390/ agronomy15010076
8. Brown, P., Daigneault, A., & Dawson, J. (2019). Age , values , farming objectives , past management decisions , and future intentions in New Zealand agriculture. *Journal of Environmental Management*, *231*(July), 110–120. https://doi.org/10.1016/j.jenvman.2018.10.018

9. Byfuglien, A., Valkengoed, A. M. Van, & Innocenti, S. (2025). Good intentions , limited action : When do farmers ' intentions to adopt sustainable farming practices turn into actual behaviour ? *Journal of Environmental Psychology*, *102*(May), 102522. https://doi.org/10.1016/j.jenvp.2025.102522
10. Cahyaningtiyas, I., Lanya, I., & Trigunasih, M. (2021). The Application of Remote Sensing and Geographics Information System for database SLA and Agrotourism in Subak Sembung, North Denpasar District. *Journal on Agriculture Science*, *11*(1), 85–96. https://doi.org/https://doi.org/10.24843/AJoAS.2021.v11.i01.p09
11. Campos, A. L. J., Monteiro, F. T., Soldati, G. T., & Fávero, C. (2025). Implications of slash-and-burn agriculture with rotation and fallow lands in traditional agricultural systems : a review. *Acta Botanica Brasilica, 39*(e20240204), 1–17. https://doi.org/https://doi.org/10.1590/1677-941X-ABB-2024-0204
12. Cao, H., Li, F., Zhao, K., Qian, C., & Xiang, T. (2022). From Value Perception to Behavioural Intention : Study of Chinese Smallholders Pro-environmental Agricultural Practices. *Journal of Enviromental Management*, *315*(1), 115179. https://doi.org/https://doi.org/10.1016/j.jenvman.2022.115179
13. Dessart, F. J., Barreiro-hurlé, J., & Bavel, R. Van. (2019). Behavioural factors affecting the adoption of sustainable farming practices : a policy- oriented review. *European Review OfAgricultural Economics Vol*, *46*(3), 417–471. https://doi.org/https://doi.org/10.1093/erae/jbz019
14. Eide, A. E., Saether, E. A., & Aspelund, A. (2020). An investigation of leaders ' motivation , intellectual leadership , and sustainability strategy in relation to Norwegian manufacturers ' performance. *Journal of Cleaner Production*, *254*, 120053. https://doi.org/https://doi.org/10.1016/j.jclepro.2020.120053
15. Frankel-Goldwater, L., Wojtynia, N., & Dueñas-ocampo, S. (2024). Healthy people , soils , and ecosystems : uncovering primary drivers in the adoption of regenerative agriculture by US farmers and ranchers. *Front. Sustain. Food Syst*, *7*(January), 1070518. https://doi.org/https://doi.org/10.3389/fsufs.2023.1070518
16. Gamage, A., Gangahagedara, R., Gamage, J., Jayasinghe, N., Kodikara, N., Suraweera, P., & Merah, O. (2023). Role of organic farming for achieving sustainability in agriculture. *Farming System*, *1*(1), 100005. https://doi.org/https://doi.org/10.1016/j.farsys.2023.100005
17. Guo, H., Xu, S., Wang, X., Shu, W., Chen, J., Pan, C., & Guo, C. (2021). Driving Mechanism of Farmers ' Utilization Behaviors of Straw Resources — An Empirical Study in Jilin Province , the Main Grain Producing Region in the Northeast Part of China. *Sustainability*, *13*, 2506. https://doi.org/https://doi.org/10.3390/ su13052506
18. Hamam, M., Chinnici, G., Vita, G. Di, Pappalardo, G., Pecorino, B., Maesano, G., & Amico, M. D. (2021). Circular Economy Models in Agro-Food Systems : A Review. *Sustainability*, *13*(3453), 1–18. https://doi.org/https:// doi.org/10.3390/su13063453
19. Haryanto, Y., Hartono, R., & Wibowo, H. T. (2023). Rural Community Empowerment through the Utilization of Straw as Compost. *Universal Journal of Agricultural Research*, *11*(1), 202–207. https://doi.org/https:// doi.org/10.13189/ujar.2023.110120
20. Herrera, S. I. O., Kallas, Z., Serebrennikov, D., & Mccarthy, S. N. (2023). Towards circular farming : factors affecting EU farmers ' decision to adopt emission-reducing innovations. *International Journal of Agricultural Sustainability*, *21*(1), 2270149. https://doi.org/https://doi.org/10.1080/14735903.2023.2270149
21. Howard, J. L., Bureau, J., Guay, F., Chong, J. X. Y., & Ryan, R. M. (2021). Student Motivation and Associated Outcomes : A Meta-Analysis From Self-Determination Theory. *Perspectives on Psychological Science 1*, *16*(6), 1300–1323. https://doi.org/https://doi.org/10.1177/1745691620966789
22. I Nengah, M. M., Sukmadewi, D. K. T., Selangga, D. G. W., Kariasa, I. G., Prawerti, D. A. D., Parwata, I. K. A., & Landra, I. W. (2022). Implementation of LEISA Concept through composting rice straw waste in Subak Telun Ayah, Tegallalang. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*, *7*(4), 663–675. https://doi.org/10.26905/abdimas.v7i4.7825
23. Jansuwan, P., & Zander, K. K. (2022). Multifunctional farming as successful pathway for the next generation of Thai farmers. *PLoS ONE*, *17*(4), e0267351. https://doi.org/http://dx.doi.org/10.1371/journal.pone.0267351
24. Jiang, L., Huang, H., He, S., & Huang, H. (2022). What motivates farmers to adopt low-carbon agricultural technologies ? Empirical evidence from thousands of rice farmers in Hubei province , central China. *Front. Psychol*, *13*, 983597. https://doi.org/http://dx.doi.org/10.3389/fpsyg.2022.983597
25. Kaur, M., Malik, D. P., Malhi, G. S., Sardana, V., Bolan, N. S., & Lal, R. (2022). Rice residue management in the Indo-Gangetic Plains for climate and food security . A review. *Agronomy for Sustainable Development (2022)*, *42*(92). https://doi.org/https://doi.org/10.1007/s13593-022-00817-0
26. Klebl, F., Feindt, P. H., & Piorr, A. (2024). Farmers ' behavioural determinants of on - farm biodiversity management in Europe : a systematic review. In *Agriculture and Human Values* (Vol. 41, Issue 2). Springer Netherlands. https://doi.org/https://doi.org/10.1007/s10460-023-10505-8
27. Li, H., & Wen, H. (2019). How Is Motivation Generated in Collaborative Consumption : Mediation Effect in Extrinsic and Intrinsic Motivation. *Sustainability*, *11*(649), 1–13. https://doi.org/https://doi.org/10.3390/su11030640
28. Li, L., Seo, S., & Choi, K. (2025). The Influence of Exercise Motivation on Exercise Adherence Intention Among Fitness Center Users : Focusing on the Mediating Role of Self-Efficacy. *The Asian Journal of Kinesiology*, *27*(3), 36–43. https://doi.org/https://doi.org/10.15758/ajk.2025.27.3.36
29. Lim, W. M. (2025). What Is Qualitative Research ? An Overview and Guidelines. *Australasian Marketing Journal*, *33*(2), 199 –229. https://doi.org/https://doi.org/10.1177/14413582241264619
30. Ma, W., & Bahadur, D. (2024). Climate-smart agriculture: adoption, impacts, and implications for sustainable development. *Mitigation and Adaptation Strategies for Global Change*, *29*(5), 1–23.
31. https://doi.org/https://doi.org/10.1007/s11027-024-10139-z
32. Mebrate, A., Zeray, N., Kippie, T., & Haile, G. (2022). Determinants of soil fertility management practices in

Gedeo Zone , Southern Ethiopia : logistic regression approach. *Heliyon*, *8*(January), e08820. https://doi.org/https://doi.org/10.1016/j.heliyon.2022.e08820e08820
33. Mwaura, G. G., Kiboi, M. N., Bett, E. K., Mugwe, J. N., Muriuki, A., Nicolay, G., & Ngetich, F. K. (2021). Adoption Intensity of Selected Organic-Based Soil Fertility Management Technologies in the Central Highlands of Kenya. *Front. Sustain. Food Syst*, *4*(January), 1–17. https://doi.org/https://doi.org/10.3389/fsufs.2020.570190
34. Nwabuko, O. C., Iwu, L. O., Njoku, P. U., Ngozi, U., Transfusion, B., Centre, F. M., State, A., Centre, F. M., State, A., Centre, F. M., & State, A. (2024). An Overview of Research Study Designs in Quantitative Research Methodology. *American Journal of Medical and Clinical Research & Reviews*, *3*(5), 1–6. https://doi.org/https://doi.org/10.58372/2835-6276.1169
35. Obiero, K. O., Waidbacher, H., & Nyawanda, B. O. (2019). Predicting uptake of aquaculture technologies among smallholder fish farmers in Kenya. *Aquaculture International (2019)*, *27*, 1689–1707. https://doi.org/https://doi.org/10.1007/s10499-019-00423-0
36. Okura, F., Budiasa, I. W., & Kato, T. (2022). Exploring a Balinese irrigation water management system using agent-based modeling and game theory. *Agricultural Water Management*, *274*(June), 107951. https://doi.org/https://doi.org/10.1016/j.agwat.2022.107951
37. Pandey, A. K., Thakur, S., Mehra, R., Sukhwinder, R., Kaler, S., Paul, M., & Kumar, A. (2025). Transforming Agri-food waste : Innovative pathways toward a zero-waste circular economy. *Food Chemistry: X*, *28*(May), 102604. https://doi.org/https://doi.org/10.1016/j.fochx.2025.
38. Parihar, D. S., Narang, M. K., Dogra, B., Prakash, A., & Mahadik, A. (2023). Rice residue burning in Northern India : an assessment of environmental concerns and potential solutions – a review. *Environ. Res. Commun*, *5*, 062001. https://doi.org/https://doi.org/10.1088/2515-7620/acb6d4
39. Rabbi, M. F., & Amin, M. Bin. (2024). Circular economy and sustainable practices in the food industry : A comprehensive bibliometric analysis. *Cleaner and Responsible Consumption*, *14*(March), 100206. https://doi.org/https://doi.org/10.1016/j.clrc.2024.100206
40. Ren, Z., & Zhong, K. (2022). Driving mechanism of subjective cognition on farmers ' adoption behavior of straw returning technology : Evidence from rice and wheat producing provinces in China. *Front. Psychol*, *13*(August), 1–14. https://doi.org/https://doi.org/10.3389/fpsyg.2022.922889
41. Risna, R. ., Rustini, H. ., Buchori, D., & Pribadi, D. . (2022). Subak , a Nature-based Solutions Evidence from Indonesia. *Earth Environ. Sci*, *959*(3033), 012030. https://doi.org/https://doi.org/10.1088/1755-1315/959/1/012030
42. Schukat, S., & Heise, H. (2021). Towards an Understanding of the Behavioral Intentions and Actual Use of Smart Products among German Farmers. *Sustainability*, *13*, 6666. https://doi.org/https://doi.org/10.3390/su13126666
43. Serebrennikov, D., Thorne, F., Kallas, Z., & McCarthy, S. N. (2020). Factors Influencing Adoption of Sustainable Farming Practices in Europe : A Systemic Review of Empirical Literature. *Sustainability*, *12*, 9719. https://doi.org/https://doi.org/10.3390/su12229719
44. Sereenonchai, S., & Arunrat, N. (2022). Farmers ' Perceptions , Insight Behavior and Communication Strategies for Rice Straw and Stubble Management in Thailand. *Agronomy*, *12*(200). https://doi.org/https://doi.org/10.3390/agronomy12010200
45. Sereenonchai, S., & Arunrat, N. (2024). Pro - Environmental Agriculture to Promote a Sustainable Lifestyle. *Sustainability*, *16*(7449). https://doi.org/https:// doi.org/10.3390/su16177449 Academic
46. Sinclair, A. H., Cosme, D., Lydic, K., Reinero, D. A., Tartak, J., & Mann, M. E. (2025). Behavioral interventions motivate action to address climate change. *PNAS*, *122*(20), e2426768122. https://doi.org/https://doi.org/10.1073/pnas.2426768122
47. Slater, P., & Hasson, F. (2025). Quantitative Research Designs , Hierarchy of Evidence and Validity. *Journal of Psychiatric and Mental Health Nursing*, *32*, 656–660. https://doi.org/https://doi.org/10.1111/jpm.13135
48. Sok, J., Borges, J. R., Schmidt, P., & Ajzen, I. (2021). Farmer Behaviour as Reasoned Action : A Critical Review of Research with the Theory of Planned Behaviour. *Journal of Agricultural Economics*, *72*(2), 388–412. https://doi.org/https://doi.org/10.1111/1477-9552.12408
49. Swart, R., Levers, C., Davis, J. T. M., & Verburg, P. H. (2023). Article Meta-analyses reveal the importance of socio- psychological factors for farmers ' adoption of sustainable agricultural practices Meta-analyses reveal the importance of socio-psychological factors for farmers ' adoption of sustainable agricultural . *One Earth*, *6*(12), 1771–1783. https://doi.org/https://doi.org/10.1016/j.oneear.2023.10.028
50. Tolinggi, W. K., Salman, D., & Iswoyo, H. (2023). Farmer regeneration and knowledge co-creation in the sustainability of coconut agribusiness in Gorontalo, Indonesia. *Open Agriculture*, *8*, 20220162. https://doi.org/https://doi.org/10.1515/opag-2022-0162
51. Tong, T., Ye, F., Zhang, Q., Liao, W., Ding, Y., Liu, Y., & Li, G. (2024). The impact of labor force aging on agricultural total factor productivity of farmers in China : implications for food sustainability. *Front. Sustain. Food Syst*, *8*(August), 1434604. https://doi.org/https://doi.org/10.3389/fsufs.2024.1434604
52. Van den Broeck, A., Howard, J. L., Vaerenbergh, Y. Van, & Leroy, H. (2021). Beyond intrinsic and extrinsic motivation : A meta-analysis on self-determination theory ' s multidimensional conceptualization of work motivation. *Organizational Psychology Review*, *11*(3), 240–273. https://doi.org/https://doi.org/10.1177/20413866211006173
53. Wulandari, P. R., Saskara, I. A. N., Yasa, I. G. W. M., & Marhaeni, A. A. I. N. (2024). KEY VARIABLES FOR FARMING BUSINESS SUSTAINABILITY IN URBAN SUBAK. *Revista de Gestão Social e Ambiental*, *18*(9), e05501. https://doi.org/https://doi.org/10.24857/rgsa.v18n9-087
54. Zen, I. ., Surata, S. P. ., Titisari, P. ., Rahman, S. ., & Zen, S. (2024). Sustaining subak , the balinese traditional ecological knowledge in the contemporary context of Bali Sustaining subak , the balinese traditional ecological

knowledge in the contemporary context of Bali. *Earth and Environmental Science*, *1306*, 012034. https://doi.org/https://doi.org/10.1088/1755-1315/1306/1/012034
55. Zeng, Y., Tian, Y., He, K., & Zhang, J. (2019). Environmental conscience , external incentives and social norms in rice farmers ' adoption of pro- environmental agricultural practices in rural Hubei province , China. *Environmental Technology*, *3330*. https://doi.org/https://doi.org/10.1080/09593330.2019.1574907
56. Zuleika, P., & Legiran. (2022). Cross-Sectional Study as Research Design in Medicine. *Archives of The Medicine and Case Reports Vol*, *3*(2), 256–259.
57. Ajzen, I. (2020). The theory of planned behavior : Frequently asked questions. *Hum Behav & Emerg Tech*, *2*(4), 314–324. https://doi.org/https://publons.com/publon/10.1002/hbe2.195
58. Atinkut, H. B., Yan, T., Zhang, F., Qin, S., & Gai, H. (2020). Cognition of agriculture waste and payments for a circular agriculture model in Central China. *Scientific Reports*, *10*(1), 10826. https://doi.org/10.1038/s41598-020-67358-y
59. Ayalew, A., & Girma, Y. (2025). The Effect of Age on Agricultural Technology Adoption by Smallholder Farmers in Ethiopia: A Systematic Review and Meta-Analysis. *Advances in Agriculture*, *2025*(1), 8881484. https://doi.org/https://doi.org/10.1155/aia/8881484
60. Begho, T., Glenk, K., Anik, A. R., & Eory, V. (2022). A systematic review of factors that influence farmers ' adoption of sustainable crop farming practices : Lessons for sustainable nitrogen management in South Asia. *J Sustain Agric Environ*, *1*(2), 149–160. https://doi.org/https://doi.org/10.1002/sae2.12016
61. Bhatt, R., Giang, A., & Kandlikar, M. (2022). Incentivizing Alternatives to Agricultural Waste burning in Northern India : Trust , Awareness , and Access as Barriers to Adoption. *Environment Systems and Decisions*, *43*(3), 358–370. https://doi.org/https://doi.org/10.21203/rs.3.rs-1586008/v1
62. Bhattacharyya, P., Bisen, J., Bhaduri, D., Priyadarsini, S., Munda, S., Chakraborti, M., Adak, T., Kumar, S., & Nimbrayan, P. (2021). Turn the wheel fromwaste towealth: Economic and environmental gain of sustainable rice straw management practices over field burning in reference to India. *Science of the Total Environment*, *775*(2021), 145896. https://doi.org/10.1016/j.scitotenv.2021.145896
63. Boros, A., Szolik, E., Desalegn, G., & Tozser, D. (2025). A Systematic Review of Opportunities and Limitations of Innovative Practices in Sustainable Agriculture. *Agronomy*, *15*(76), 1–40. https://doi.org/https://doi.org/10.3390/ agronomy15010076
64. Brown, P., Daigneault, A., & Dawson, J. (2019). Age , values , farming objectives , past management decisions , and future intentions in New Zealand agriculture. *Journal of Environmental Management*, *231*(July), 110–120. https://doi.org/10.1016/j.jenvman.2018.10.018
65. Byfuglien, A., Valkengoed, A. M. Van, & Innocenti, S. (2025). Good intentions , limited action : When do farmers ' intentions to adopt sustainable farming practices turn into actual behaviour ? *Journal of Environmental Psychology*, *102*(May), 102522. https://doi.org/10.1016/j.jenvp.2025.102522
66. Cahyaningtiyas, I., Lanya, I., & Trigunasih, M. (2021). The Application of Remote Sensing and Geographics Information System for database SLA and Agrotourism in Subak Sembung, North Denpasar District. *Journal on Agriculture Science*, *11*(1), 85–96. https://doi.org/https://doi.org/10.24843/AJoAS.2021.v11.i01.p09
67. Campos, A. L. J., Monteiro, F. T., Soldati, G. T., & Fávero, C. (2025). Implications of slash-and-burn agriculture with rotation and fallow lands in traditional agricultural systems : a review. *Acta Botanica Brasilica, 39*(e20240204), 1–17. https://doi.org/https://doi.org/10.1590/1677-941X-ABB-2024-0204
68. Cao, H., Li, F., Zhao, K., Qian, C., & Xiang, T. (2022). From Value Perception to Behavioural Intention : Study of Chinese Smallholders Pro-environmental Agricultural Practices. *Journal of Enviromental Management*, *315*(1), 115179. https://doi.org/https://doi.org/10.1016/j.jenvman.2022.115179
69. Dessart, F. J., Barreiro-hurlé, J., & Bavel, R. Van. (2019). Behavioural factors affecting the adoption of sustainable farming practices : a policy- oriented review. *European Review OfAgricultural Economics Vol*, *46*(3), 417–471. https://doi.org/https://doi.org/10.1093/erae/jbz019
70. Eide, A. E., Saether, E. A., & Aspelund, A. (2020). An investigation of leaders ' motivation , intellectual leadership , and sustainability strategy in relation to Norwegian manufacturers ' performance. *Journal of Cleaner Production*, *254*, 120053. https://doi.org/https://doi.org/10.1016/j.jclepro.2020.120053
71. Frankel-Goldwater, L., Wojtynia, N., & Dueñas-ocampo, S. (2024). Healthy people , soils , and ecosystems : uncovering primary drivers in the adoption of regenerative agriculture by US farmers and ranchers. *Front. Sustain. Food Syst*, *7*(January), 1070518. https://doi.org/https://doi.org/10.3389/fsufs.2023.1070518
72. Gamage, A., Gangahagedara, R., Gamage, J., Jayasinghe, N., Kodikara, N., Suraweera, P., & Merah, O. (2023). Role of organic farming for achieving sustainability in agriculture. *Farming System*, *1*(1), 100005. https://doi.org/https://doi.org/10.1016/j.farsys.2023.100005
73. Guo, H., Xu, S., Wang, X., Shu, W., Chen, J., Pan, C., & Guo, C. (2021). Driving Mechanism of Farmers ' Utilization Behaviors of Straw Resources — An Empirical Study in Jilin Province , the Main Grain Producing Region in the Northeast Part of China. *Sustainability*, *13*, 2506. https://doi.org/https://doi.org/10.3390/ su13052506
74. Hamam, M., Chinnici, G., Vita, G. Di, Pappalardo, G., Pecorino, B., Maesano, G., & Amico, M. D. (2021). Circular Economy Models in Agro-Food Systems : A Review. *Sustainability*, *13*(3453), 1–18. https://doi.org/https:// doi.org/10.3390/su13063453
75. Haryanto, Y., Hartono, R., & Wibowo, H. T. (2023). Rural Community Empowerment through the Utilization of Straw as Compost. *Universal Journal of Agricultural Research*, *11*(1), 202–207. https://doi.org/https:// doi.org/10.13189/ujar.2023.110120
76. Herrera, S. I. O., Kallas, Z., Serebrennikov, D., & Mccarthy, S. N. (2023). Towards circular farming : factors affecting EU farmers ' decision to adopt emission-reducing innovations. *International Journal of Agricultural*

Sustainability, *21*(1), 2270149. https://doi.org/https://doi.org/10.1080/14735903.2023.2270149
77. Howard, J. L., Bureau, J., Guay, F., Chong, J. X. Y., & Ryan, R. M. (2021). Student Motivation and Associated Outcomes : A Meta-Analysis From Self-Determination Theory. *Perspectives on Psychological Science 1*, *16*(6), 1300–1323. https://doi.org/https://doi.org/10.1177/1745691620966789
78. I Nengah, M. M., Sukmadewi, D. K. T., Selangga, D. G. W., Kariasa, I. G., Prawerti, D. A. D., Parwata, I. K. A., & Landra, I. W. (2022). Implementation of LEISA Concept through composting rice straw waste in Subak Telun Ayah, Tegallalang. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*, *7*(4), 663–675. https://doi.org/10.26905/abdimas.v7i4.7825
79. Jansuwan, P., & Zander, K. K. (2022). Multifunctional farming as successful pathway for the next generation of Thai farmers. *PLoS ONE*, *17*(4), e0267351. https://doi.org/http://dx.doi.org/10.1371/journal.pone.0267351
80. Jiang, L., Huang, H., He, S., & Huang, H. (2022). What motivates farmers to adopt low-carbon agricultural technologies ? Empirical evidence from thousands of rice farmers in Hubei province , central China. *Front. Psychol*, *13*, 983597. https://doi.org/http://dx.doi.org/10.3389/fpsyg.2022.983597
81. Kaur, M., Malik, D. P., Malhi, G. S., Sardana, V., Bolan, N. S., & Lal, R. (2022). Rice residue management in the Indo-Gangetic Plains for climate and food security . A review. *Agronomy for Sustainable Development (2022)*, *42*(92). https://doi.org/https://doi.org/10.1007/s13593-022-00817-0
82. Klebl, F., Feindt, P. H., & Piorr, A. (2024). Farmers ' behavioural determinants of on - farm biodiversity management in Europe : a systematic review. In *Agriculture and Human Values* (Vol. 41, Issue 2). Springer Netherlands. https://doi.org/https://doi.org/10.1007/s10460-023-10505-8
83. Li, H., & Wen, H. (2019). How Is Motivation Generated in Collaborative Consumption : Mediation Effect in Extrinsic and Intrinsic Motivation. *Sustainability*, *11*(649), 1–13. https://doi.org/https://doi.org/10.3390/su11030640
84. Li, L., Seo, S., & Choi, K. (2025). The Influence of Exercise Motivation on Exercise Adherence Intention Among Fitness Center Users : Focusing on the Mediating Role of Self-Efficacy. *The Asian Journal of Kinesiology*, *27*(3), 36–43. https://doi.org/https://doi.org/10.15758/ajk.2025.27.3.36
85. Lim, W. M. (2025). What Is Qualitative Research ? An Overview and Guidelines. *Australasian Marketing Journal*, *33*(2), 199 –229. https://doi.org/https://doi.org/10.1177/14413582241264619
86. Ma, W., & Bahadur, D. (2024). Climate-smart agriculture: adoption, impacts, and implications for sustainable development. *Mitigation and Adaptation Strategies for Global Change*, *29*(5), 1–23. https://doi.org/https://doi.org/10.1007/s11027-024-10139-z
87. Mebrate, A., Zeray, N., Kippie, T., & Haile, G. (2022). Determinants of soil fertility management practices in Gedeo Zone , Southern Ethiopia : logistic regression approach. *Heliyon*, *8*(January), e08820. https://doi.org/https://doi.org/10.1016/j.heliyon.2022.e08820e08820
88. Mwaura, G. G., Kiboi, M. N., Bett, E. K., Mugwe, J. N., Muriuki, A., Nicolay, G., & Ngetich, F. K. (2021). Adoption Intensity of Selected Organic-Based Soil Fertility Management Technologies in the Central Highlands of Kenya. *Front. Sustain. Food Syst*, *4*(January), 1–17. https://doi.org/https://doi.org/10.3389/fsufs.2020.570190
89. Nwabuko, O. C., Iwu, L. O., Njoku, P. U., Ngozi, U., Transfusion, B., Centre, F. M., State, A., Centre, F. M., State, A., Centre, F. M., & State, A. (2024). An Overview of Research Study Designs in Quantitative Research Methodology. *American Journal of Medical and Clinical Research & Reviews*, *3*(5), 1–6. https://doi.org/https://doi.org/10.58372/2835-6276.1169
90. Obiero, K. O., Waidbacher, H., & Nyawanda, B. O. (2019). Predicting uptake of aquaculture technologies among smallholder fish farmers in Kenya. *Aquaculture International (2019)*, *27*, 1689–1707. https://doi.org/https://doi.org/10.1007/s10499-019-00423-0
91. Okura, F., Budiasa, I. W., & Kato, T. (2022). Exploring a Balinese irrigation water management system using agent-based modeling and game theory. *Agricultural Water Management*, *274*(June), 107951. https://doi.org/https://doi.org/10.1016/j.agwat.2022.107951
92. Pandey, A. K., Thakur, S., Mehra, R., Sukhwinder, R., Kaler, S., Paul, M., & Kumar, A. (2025). Transforming Agri-food waste : Innovative pathways toward a zero-waste circular economy. *Food Chemistry: X*, *28*(May), 102604. https://doi.org/https://doi.org/10.1016/j.fochx.2025.
93. Parihar, D. S., Narang, M. K., Dogra, B., Prakash, A., & Mahadik, A. (2023). Rice residue burning in Northern India : an assessment of environmental concerns and potential solutions – a review. *Environ. Res. Commun*, *5*, 062001. https://doi.org/https://doi.org/10.1088/2515-7620/acb6d4
94. Rabbi, M. F., & Amin, M. Bin. (2024). Circular economy and sustainable practices in the food industry : A comprehensive bibliometric analysis. *Cleaner and Responsible Consumption*, *14*(March), 100206. https://doi.org/https://doi.org/10.1016/j.clrc.2024.100206
95. Ren, Z., & Zhong, K. (2022). Driving mechanism of subjective cognition on farmers ' adoption behavior of straw returning technology : Evidence from rice and wheat producing provinces in China. *Front. Psychol*, *13*(August), 1–14. https://doi.org/https://doi.org/10.3389/fpsyg.2022.922889
96. Risna, R. ., Rustini, H. ., Buchori, D., & Pribadi, D. . (2022). Subak , a Nature-based Solutions Evidence from Indonesia. *Earth Environ. Sci*, *959*(3033), 012030. https://doi.org/https://doi.org/10.1088/1755-1315/959/1/012030
97. Schukat, S., & Heise, H. (2021). Towards an Understanding of the Behavioral Intentions and Actual Use of Smart Products among German Farmers. *Sustainability*, *13*, 6666. https://doi.org/https://doi.org/10.3390/su13126666
98. Serebrennikov, D., Thorne, F., Kallas, Z., & McCarthy, S. N. (2020). Factors Influencing Adoption of Sustainable Farming Practices in Europe : A Systemic Review of Empirical Literature. *Sustainability*, *12*, 9719. https://doi.org/https://doi.org/10.3390/su12229719
99. Sereenonchai, S., & Arunrat, N. (2022). Farmers ' Perceptions , Insight Behavior and Communication Strategies

for Rice Straw and Stubble Management in Thailand. *Agronomy*, *12*(200). https://doi.org/https://doi.org/10.3390/agronomy12010200

100. Sereenonchai, S., & Arunrat, N. (2024). Pro - Environmental Agriculture to Promote a Sustainable Lifestyle. *Sustainability*, *16*(7449). https://doi.org/https:// doi.org/10.3390/su16177449 Academic
101. Sinclair, A. H., Cosme, D., Lydic, K., Reinero, D. A., Tartak, J., & Mann, M. E. (2025). Behavioral interventions motivate action to address climate change. *PNAS*, *122*(20), e2426768122. https://doi.org/https://doi.org/10.1073/pnas.2426768122
102. Slater, P., & Hasson, F. (2025). Quantitative Research Designs , Hierarchy of Evidence and Validity. *Journal of Psychiatric and Mental Health Nursing*, *32*, 656–660. https://doi.org/https://doi.org/10.1111/jpm.13135
103. Sok, J., Borges, J. R., Schmidt, P., & Ajzen, I. (2021). Farmer Behaviour as Reasoned Action : A Critical Review of Research with the Theory of Planned Behaviour. *Journal of Agricultural Economics*, *72*(2), 388–412. https://doi.org/https://doi.org/10.1111/1477-9552.12408
104. Swart, R., Levers, C., Davis, J. T. M., & Verburg, P. H. (2023). Article Meta-analyses reveal the importance of socio- psychological factors for farmers ' adoption of sustainable agricultural practices Meta-analyses reveal the importance of socio-psychological factors for farmers ' adoption of sustainable agricultural . *One Earth*, *6*(12), 1771–1783. https://doi.org/https://doi.org/10.1016/j.oneear.2023.10.028
105. Tolinggi, W. K., Salman, D., & Iswoyo, H. (2023). Farmer regeneration and knowledge co-creation in the sustainability of coconut agribusiness in Gorontalo, Indonesia. *Open Agriculture*, *8*, 20220162. https://doi.org/https://doi.org/10.1515/opag-2022-0162
106. Tong, T., Ye, F., Zhang, Q., Liao, W., Ding, Y., Liu, Y., & Li, G. (2024). The impact of labor force aging on agricultural total factor productivity of farmers in China : implications for food sustainability. *Front. Sustain. Food Syst*, *8*(August), 1434604. https://doi.org/https://doi.org/10.3389/fsufs.2024.1434604
107. Van den Broeck, A., Howard, J. L., Vaerenbergh, Y. Van, & Leroy, H. (2021). Beyond intrinsic and extrinsic motivation : A meta-analysis on self-determination theory ' s multidimensional conceptualization of work motivation. *Organizational Psychology Review*, *11*(3), 240–273. https://doi.org/https://doi.org/10.1177/20413866211006173
108. Wulandari, P. R., Saskara, I. A. N., Yasa, I. G. W. M., & Marhaeni, A. A. I. N. (2024). KEY VARIABLES FOR FARMING BUSINESS SUSTAINABILITY IN URBAN SUBAK. *Revista de Gestão Social e Ambiental*, *18*(9), e05501. https://doi.org/https://doi.org/10.24857/rgsa.v18n9-087
109. Zen, I. ., Surata, S. P. ., Titisari, P. ., Rahman, S. ., & Zen, S. (2024). Sustaining subak , the balinese traditional ecological knowledge in the contemporary context of Bali Sustaining subak , the balinese traditional ecological knowledge in the contemporary context of Bali. *Earth and Environmental Science*, *1306*, 012034. https://doi.org/https://doi.org/10.1088/1755-1315/1306/1/012034
110. Zeng, Y., Tian, Y., He, K., & Zhang, J. (2019). Environmental conscience , external incentives and social norms in rice farmers ' adoption of pro- environmental agricultural practices in rural Hubei province , China. *Environmental Technology*, *3330*. https://doi.org/https://doi.org/10.1080/09593330.2019.1574907
111. Zuleika, P., & Legiran. (2022). Cross-Sectional Study as Research Design in Medicine. *Archives of The Medicine and Case Reports Vol*, *3*(2), 256–259.