Research Article

Determinants of Sustained Implementation in Integrated Goat–Coffee Farming Systems

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Abstract | Integrated crop–livestock systems are increasingly promoted as pathways to sustainable agricultural intensification because they enhance nutrient cycling, reduce dependence on external inputs, and improve farm resilience. In perennial coffee systems, integrating goats into coffee production may generate agronomic benefits through manure utilisation, biomass recycling, and income diversification. However, sustaining integrated farming practices remains behaviourally challenging because implementation requires continuous managerial coordination, technical competence, and long-term resource commitment. This study investigates the determinants of sustained implementation in integrated goat–coffee farming systems using an extended Theory of Planned Behaviour (TPB) framework. Survey data were collected from 100 smallholder coffee farmers in Malang Regency, Indonesia, all of whom owned goats and had implemented goat–coffee integration practices. Partial least squares structural equation modelling (PLS-SEM) was used to examine associations among attitude (ATT), subjective norm (SN), perceived behavioural control (PBC), intention (INT), sustained implementation (SI), and two additional normative constructs: injunctive group norm (IGN), which represents perceived social approval from relevant groups, and descriptive group norm (DGN), which represents the perceived prevalence of implementation behaviour among peers. The results indicate that attitude was the strongest predictor of intention ($\beta = 0.634$; $p < 0.001$), whereas subjective norm, PBC, injunctive group norm, and descriptive group norm were also positively associated with intention. Sustained implementation behaviour was strongly associated with both intention ($\beta = 0.537$; $p < 0.001$) and PBC ($\beta = 0.525$; $p < 0.001$). These findings provide empirical insights for future research and implementation support strategies aimed at strengthening the continuity of integrated crop–livestock systems.

Keywords | Integrated crop–livestock systems, Sustained implementation, Perceived behavioural control, Perennial coffee systems, Smallholder agriculture, Social norms

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INTRODUCTION

Integrated crop–livestock systems are increasingly promoted as pathways to sustainable agricultural intensification because they enhance nutrient cycling, reduce reliance on external inputs, and improve farm resilience (Genest-Richard *et al.*, 2025; Lemaire *et al.*, 2023; Moojen *et al.*, 2024; Yang *et al.*, 2022). In perennial coffee systems, integrating goats into production can generate agronomic and economic benefits through manure utilisation, biomass recycling, and income diversification (De Pascale and Guadagno, 2025; Khatri *et al.*, 2023; Notaro *et al.*, 2022; Wulandari *et al.*, 2020). However, maintaining integrated farming practices

requires sustained managerial coordination and technical commitment (Ahmad *et al*., 2025; Timpanaro *et al*., 2023). The potential for crop–livestock integration is particularly relevant in smallholder coffee systems, which often face soil degradation, market volatility, and climate-related risks (Rahman *et al*., 2023; Cunha *et al*., 2026). Integrating goats into coffee plantations can therefore provide multiple agronomic and economic co-benefits (Ashardiono and Trihartono, 2024; Notaro *et al*., 2022; Wulandari *et al*., 2020). Despite these advantages, the consistency and intensity of goat–coffee integration remain highly variable among smallholder farmers.

Although technical and economic factors are commonly addressed in the agricultural adoption literature, this study focuses specifically on the behavioural and perceived-capability mechanisms that underlie sustained implementation. Research on integrated crop–livestock systems and other sustainable agricultural practices highlights several non-technical barriers that influence implementation decisions (Cheboi *et al*., 2023; Pilarski *et al*., 2025; Purwanti *et al*., 2023; Ujj *et al*., 2025). These findings indicate that implementation is shaped not only by practical considerations but also by subjective perceptions, social contexts, and perceived capability. Therefore, variation in sustained implementation should be understood as reflecting behavioural, social, and perceived-capability influences, rather than purely technical considerations.

The Theory of Planned Behaviour (TPB) has demonstrated strong explanatory power across diverse agricultural practices (Dey and Singh, 2023; Dong *et al*., 2022; Sun *et al*., 2022; Tama *et al*., 2021; Yang *et al*., 2024). Recent extensions of TPB emphasise the influence of injunctive and descriptive norms on decision-making under uncertainty. Injunctive norms capture perceived social approval from important referent groups, whereas descriptive norms reflect farmers' perceptions of how widely integration practices are adopted by their peers (Bonke and Musshoff, 2020; Westerink *et al*., 2021).

Although conceptually related, subjective norm, injunctive group norm, and descriptive group norm represent distinct forms of social influence. Subjective norm reflects perceived expectations from important referents regarding whether a behaviour should be performed (Mohammadrezaei *et al*., 2023). In contrast, injunctive group norm captures perceived social approval within a farmer's social network, whereas descriptive group norm reflects perceptions of how commonly the behaviour is practised by peers. Thus, the three constructs capture expectations, approval, and behavioural prevalence, respectively.

Despite the growing application of TPB in agricultural research, several gaps remain. First, although TPB has been applied to crop–livestock integration and other sustainable agricultural practices, existing studies have predominantly focused on adoption decisions rather than on variation in sustained implementation among existing adopters. Second, while injunctive and descriptive norms have been examined in previous TPB studies, limited attention has been given to their distinct roles in integrated crop–livestock implementation contexts, particularly among smallholder farmers managing complex farming systems. Third, TPB-based studies provide limited evidence on the relative importance of attitudinal, normative, and perceived-capability factors in explaining variation in sustained implementation among existing adopters of integrated farming systems (Savari *et al*., 2023; Yuan *et al*., 2025).

To address these gaps, this study investigates the determinants of sustained implementation in integrated goat–coffee farming systems using an extended TPB framework. Rather than examining initial adoption decisions, the study analyses variation in sustained implementation among farmers who have already adopted goat–coffee integration practices (Ujj *et al*., 2025). Specifically, it evaluates the relative roles of attitudinal, normative, and perceived-capability factors in shaping implementation behaviour. By extending TPB through conceptually distinct normative constructs and by focusing on sustained implementation in a perennial integrated farming context, this study contributes to a more nuanced understanding of behavioural variation among existing adopters and offers insights for future implementation support and agricultural extension strategies.

MATERIALS AND METHODS

Research design and analytical framework

This study employed a cross-sectional quantitative research design grounded in an extended TPB framework to examine associations among implementation intention, sustained implementation behaviour, and attitudinal, normative, and perceived-capability correlates among smallholder farmers engaged in integrated goat–coffee farming systems. TPB is particularly relevant in this context because integrated crop–livestock implementation involves voluntary and behaviourally complex decision-making processes rather than purely technical choices (Sarma *et al*., 2025). The framework incorporates injunctive and descriptive group norms to capture the social embeddedness of implementation decisions and peer-based social learning in smallholder settings. Rather than examining temporal behavioural transitions or causal progression, the analytical framework examines theoretically informed associations among attitudinal, normative, perceived-capability, and implementation-related constructs. Given the cross-sectional nature of the data, the estimated relationships should not be interpreted

as evidence of causal directionality or temporal sequencing. Instead, the model provides insights into the behavioural correlates of variation in sustained implementation among existing adopters of integrated goat–coffee farming systems (Chepng'etich *et al*.,2025; Opdenbosch and Hansson,2023).

In this study, sustained implementation refers to respondents' self-reported continuation and regular application of goat–coffee integration practices after initial adoption. The construct captures variation in current implementation levels among existing adopters, rather than longitudinal behavioural persistence observed across multiple time points.

Study area

The research was conducted in Wonosari, Dampit, and Kromengan Districts of Malang Regency, East Java, Indonesia, one of the country's major smallholder coffee-producing regions. The purposive selection of districts with active farmer groups and agricultural extension support enabled the study to focus on farmers operating within established integration environments. However, this sampling strategy may limit the transferability of the findings to locations where extension services, farmer organisations, or integration support mechanisms are less developed. The selected locations share relatively similar smallholder-based coffee production systems and emerging crop–livestock integration practices, making them suitable for examining variation in sustained implementation within a comparable institutional context (Notaro *et al*., 2022). Figure 1 illustrates the geographic location of the study area within Malang Regency, East Java, Indonesia.

Population and sampling procedure

The target population comprised smallholder coffee farmers in Malang Regency who owned goats and were engaged in crop–livestock integration practices. Given the study's focus on understanding sustained implementation behaviour among farmers for whom implementation was technically feasible, a purposive sampling strategy was employed. The inclusion criteria were as follows:

1. a minimum of five years of experience in coffee farming; and
2. ownership of goats integrated into coffee farming activities.

A total of 100 respondents were included in the final sample. Although the sample size was relatively modest, it exceeded the minimum requirement suggested by the maximum-arrow criterion commonly applied in PLS-SEM.

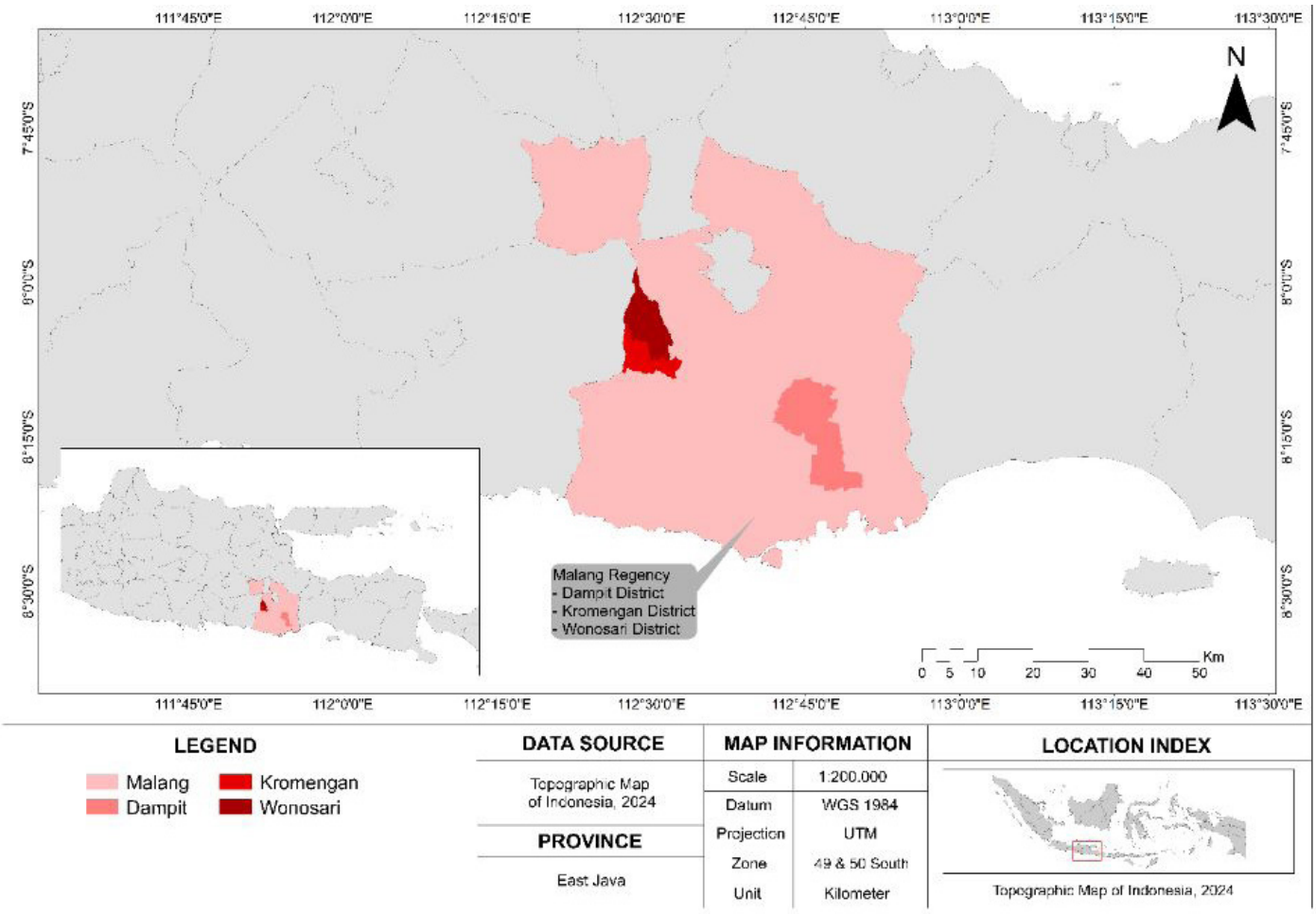

Figure 1: Study area.

In the present model, the largest number of structural paths directed at a single endogenous construct was six, indicating a minimum recommended sample size of 60 observations under this criterion. The final sample of 100 respondents therefore exceeded the recommended threshold. PLS-SEM remained appropriate given the exploratory and prediction-oriented nature of the study, the use of latent constructs, and the purposive focus on variation in sustained implementation among existing adopters of goat–coffee integration systems. The purposive sampling strategy was designed to examine variation in sustained implementation among existing adopters rather than to compare adopters and non-adopters. Accordingly, the findings reflect variation in sustained implementation among goat-owning coffee farmers operating within established integrated farming environments and should be interpreted within the context of the study population.

Data collection procedure and ethical considerations

Primary data were collected through face-to-face structured interviews to facilitate accurate interpretation of behavioural constructs within the rural smallholder context. The study adhered to established ethical standards by obtaining voluntary informed consent from all participants and ensuring anonymity and confidentiality throughout the research process. All responses were analysed in aggregate form to prevent the identification of individual respondents (Putritamara *et al*., 2023).

Given the study's focus on variation in sustained implementation among existing adopters, interviews were conducted exclusively with active goat-owning coffee farmers who had already initiated goat–coffee integration practices. Contextual verification involved confirming the presence of goats, coffee cultivation activities, and visible integration practices during farm visits whenever possible. These observations were not used as formal validation measures but helped improve consistency between reported and observed farming conditions. In addition, procedural anonymity and neutral questionnaire wording were applied to reduce potential social desirability bias. During the interviews, enumerators explained that consistent implementation referred to the regular incorporation of goat–coffee integration practices into routine farm management, rather than occasional or experimental use.

Data collection was conducted within a single agricultural production cycle between December 2025 and March 2026. Although seasonal variation may influence certain farming activities, all respondents were surveyed within the same general production period, thereby reducing substantial temporal variation across observations.

Measurement and instrument development

All latent constructs, including Attitude (ATB), Subjective Norm (SN), Perceived Behavioural Control (PBC), Injunctive Group Norm (IGN), Descriptive Group Norm (DGN), Intention (INT), and Sustained Implementation (SI), were measured using reflective multi-item indicators on a five-point Likert scale (1= strongly disagree, 5= strongly agree). Measurement items were adapted from validated TPB instruments, refined through forward–backward translation, and assessed for content validity by agricultural economists and extension specialists. The questionnaire was initially developed in English and translated into Indonesian by a bilingual agricultural researcher. A second bilingual expert independently back-translated the instrument into English. Any discrepancies were discussed and reconciled by the research team. Before the main survey, the questionnaire was pilot-tested with ten coffee farmers to ensure clarity, relevance, and contextual appropriateness. The sustained implementation construct was operationalised as the continuity and consistency of goat–coffee integration practices, rather than temporary or one-time experimentation. Accordingly, the indicators were designed to capture the regular application of integration practices within ongoing farming activities. This operationalisation aligns with the study's focus on variation in sustained implementation among existing adopters rather than binary adoption status.

Data analysis and common method bias assessment

Data were analysed using PLS-SEM in SmartPLS 3.0, which is suitable for exploratory and prediction-oriented behavioural modelling involving latent constructs and complex structural relationships. To mitigate common method bias (CMB), the study applied procedural anonymity, neutral item wording, and statistical diagnostics. Harman's single-factor test was employed as a supplementary diagnostic rather than as a standalone assessment. The first factor accounted for less than 50% of the total variance, suggesting that common method bias was unlikely to substantially affect the findings. In addition, procedural remedies were implemented throughout the data collection process to further minimise potential method-related bias. The evaluation followed a two-step procedure. First, the measurement model was assessed for reliability (Cronbach's alpha and composite reliability), convergent validity (AVE), and discriminant validity (HTMT and cross-loadings). Second, the structural model was assessed using 5,000 bootstrap resamples to examine path coefficients, R^2 values, and predictive relevance. Model fit was evaluated using SRMR, and indirect effects were tested to assess the mediating role of intention within the extended TPB framework. SRMR and NFI were reported as descriptive model-fit information rather than

definitive goodness-of-fit criteria, consistent with current recommendations for PLS-SEM applications.

RESULTS AND DISCUSSION

Farmer profile and general characteristics

Based on survey data from 100 farmers implementing integrated goat–coffee systems, the descriptive profile of respondents is presented in Table 1.

Table 1: Respondent characteristics.

Description	Percentage (%)
Gender	
Male	91
Female	9
Education	
Primary Education	54
Senior Education	40
Undergraduate Degree	6
Age	
≤ 50 years	31
>50 years	69
Farming experiences	
≤ 10 years	6
> 10 years	94
Number of livestock	
Small Scale (<10 goats)	5
Medium Scale (11-30 goats)	73
Large Scale (>31 goats)	22
Land area	
< 1 Ha	64
1-2 Ha	27
2-5 Ha	3
> 5 Ha	6

The sample was predominantly male (91%), reflecting the gendered division of labour and farm decision-making commonly observed in rural goat–coffee farming systems in Indonesia. However, the limited representation of female farmers should be considered when interpreting the findings because gender-specific behavioural patterns could not be examined in the present study. The respondent population was relatively older, with 69% aged over 50 years and 94% having more than 11 years of farming experience. This demographic profile suggests that the findings primarily reflect the perspectives of established and experienced farmers. Consequently, caution is warranted when extending the results to younger farmers, who may have different behavioural orientations, resource conditions, and implementation strategies. Educational attainment was generally low to moderate: most respondents had completed primary education (54%) or senior secondary education (40%), while only 6% held undergraduate degrees. Most respondents managed medium-scale livestock systems (73%).

Landholding size was predominantly small, with 64% of respondents managing less than 1 hectare and 27% operating between 1 and 2 hectares, confirming the smallholder nature of these farming systems. The predominance of small landholdings indicates that the findings primarily reflect the circumstances of smallholder farming systems. Therefore, the extent to which the observed behavioural patterns apply to larger-scale farming operations remains uncertain and warrants further investigation. Although all respondents reported owning their agricultural land, their holdings were generally limited in scale and reflected intergenerational family-based ownership patterns common in coffee-producing rural areas. All respondents actively managed livestock; however, livestock farming was generally treated as a secondary occupation rather than the primary source of livelihood. This suggests that goat–coffee integration was implemented alongside other economic activities and may therefore compete for labour, time, and managerial attention. Because the study did not collect detailed information on time allocation or livestock income relative to coffee farming, the implications of livelihood dependence for implementation behaviour should be interpreted with caution.

Measurement and structural model evaluation

The measurement model was assessed before the structural relationships were evaluated. All constructs demonstrated satisfactory reliability and validity according to established PLS-SEM criteria. Cronbach's alpha (CA) and composite reliability (CR) values exceeded the recommended threshold of 0.70, while average variance extracted (AVE) values were above 0.50, confirming convergent validity. Although the Sustained Implementation construct exhibited a comparatively lower Cronbach's alpha than the other constructs, its reliability remained acceptable and was supported by satisfactory composite reliability and convergent validity statistics.

Table 2 presents the cross-loading matrix used to assess discriminant validity. All indicators loaded most strongly on their intended constructs relative to alternative constructs. Although several indicators exhibited moderate cross-loadings, all indicators loaded substantially higher on their intended constructs than on any alternative construct, thereby supporting discriminant validity. This pattern is consistent with the conceptual proximity expected between motivational intention and behavioural continuation within the TPB framework.

Table 2: Cross loading matrix.

	SI	ATB	DGN	IGN	INT	PBC	SN
X1.1	0,219	0,908	-0,139	0,137	0,507	-0,149	0,009
X1.2	0,390	0,943	-0,134	0,203	0,635	0,028	0,092
X1.3	0,383	0,944	-0,107	0,086	0,604	-0,027	0,109
X1.4	0,295	0,955	-0,166	0,024	0,538	-0,070	0,013
X2.1	0,230	0,080	0,185	-0,031	0,241	-0,038	0,962
X2.2	0,254	0,059	0,247	-0,040	0,258	-0,027	0,955
X2.3	0,241	0,049	0,169	0,016	0,258	-0,009	0,957
X3.1	0,502	-0,070	-0,063	-0,072	0,096	0,914	-0,052
X3.2	0,496	-0,058	-0,110	-0,100	0,054	0,948	-0,039
X3.3	0,587	-0,016	-0,140	-0,066	0,130	0,920	0,013
X4.1	0,022	0,101	0,068	0,879	0,182	-0,150	-0,035
X4.2	0,147	0,146	0,116	0,945	0,351	-0,078	-0,004
X4.3	0,166	0,080	0,082	0,926	0,245	-0,036	-0,025
X5.1	0,034	-0,178	0,919	0,006	0,175	-0,160	0,252
X5.2	0,154	-0,130	0,971	0,139	0,317	-0,085	0,222
X5.3	0,069	-0,115	0,940	0,103	0,210	-0,107	0,121
Y1.1	0,908	0,338	0,166	0,174	0,617	0,557	0,231
Y2.1	0,869	0,283	0,010	0,062	0,538	0,456	0,217
Z1.1	0,620	0,625	0,240	0,264	0,966	0,091	0,190
Z2.1	0,635	0,602	0,244	0,307	0,963	0,080	0,262
Z3.1	0,623	0,542	0,281	0,300	0,949	0,126	0,308

Table 3: HTMT matrix.

	SI	ATB	DGN	IGN	INT	PBC	SN
SI							
ATB	0,407						
DGN	0,124	0,159					
IGN	0,159	0,124	0,093				
INT	0,774	0,637	0,261	0,302			
PBC	0,687	0,083	0,131	0,106	0,108		
SN	0,300	0,064	0,220	0,038	0,276	0,041	

As shown in Table 3, the highest HTMT value was observed between Intention and Sustained Implementation (HTMT = 0.774). Nevertheless, this value remained below the recommended threshold of 0.85, supporting discriminant validity. Accordingly, the results indicate that Intention and Sustained Implementation represent related but empirically distinguishable constructs.

Collinearity and model fit

Table 4 summarises the structural model assessment. All inner VIF values ranged from 1.107 to 2.518, indicating no critical multicollinearity concerns. Model-fit indicators were satisfactory, with SRMR values of 0.053 for both the saturated and estimated models. Consistent with current PLS-SEM reporting practices, NFI (0.838) is presented as supplementary descriptive information rather than as a definitive goodness-of-fit criterion. The model explained 60.3% of the variance in Intention (adjusted R^2 = 0.582) and 69.8% of the variance in Sustained Implementation (adjusted R^2 = 0.679), indicating moderate-to-substantial explanatory power. Predictive relevance was also supported, with Q^2 values of 0.531 for Intention and 0.509 for Sustained Implementation. The relatively high R^2 and Q^2 values likely reflect the behavioural homogeneity of the study population, which consisted exclusively of existing adopters of goat–coffee integration practices. These statistics should therefore be interpreted as indicators of in-sample explanatory and predictive relevance, rather than out-of-sample predictive performance.

Table 4: Structural model evaluation result.

Dimension	Construct	Statistic	Value
Model Fit	Overall Model	SRMR (Saturated)	0.053
Model Fit	Overall Model	SRMR (Estimated)	0.053
Model Fit	Overall Model	NFI	0.838
Explanatory Power	Intention	R^2	0.603
Explanatory Power	Intention	Adjusted R^2	0.582
Explanatory Power	Sustained Implementation	R^2	0.698
Explanatory Power	Sustained Implementation	Adjusted R^2	0.679
Predictive Relevance	Intention	Q^2	0.531
Predictive Relevance	Sustained Implementation	Q^2	0.509
Collinearity	Intention	Maximum Inner VIF	1.107
Collinearity	Sustained Implementation	Maximum Inner VIF	2.518

The effect-size assessment further indicated substantial variation in the practical importance of individual predictors. PBC exhibited a large effect on Sustained Implementation (f^2 = 0.817), while Intention also demonstrated a large effect (f^2 = 0.380). For intention formation, Attitude demonstrated the largest effect size (f^2 = 0.958), indicating that favourable evaluations of goat–coffee integration constituted the dominant correlate of intention formation within the model. In contrast, the direct effects of Attitude, Injunctive Group Norm, and Descriptive Group Norm on Sustained Implementation were associated with negligible effect sizes ($f^2 \leq 0.002$), consistent with their non-significant path coefficients.

Determinants of intention and sustained implementation in integrated goat–coffee farming systems

The results of hypothesis testing are summarised in Table 5.

Table 5: Hypothesis testing result.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
Direct effect						
ATB -> SI	0,037	0,040	0,068	0,548	0,584	Rejected
ATB -> INT	0,634	0,627	0,079	8,016	0,000***	Accepted
DGN -> SI	0,002	0,005	0,065	0,028	0,977	Rejected
DGN -> INT	0,323	0,328	0,084	3,836	0,000***	Accepted
IGN -> SI	0,018	0,021	0,064	0,276	0,783	Rejected
IGN -> INT	0,211	0,204	0,067	3,162	0,002**	Accepted
INT -> SI	0,537	0,541	0,102	5,271	0,000***	Accepted
PBC -> SI	0,525	0,521	0,085	6,190	0,000***	Accepted
PBC -> INT	0,194	0,187	0,066	2,952	0,003**	Accepted
SN -> SI	0,122	0,120	0,056	2,192	0,029*	Accepted
SN -> INT	0,164	0,153	0,070	2,358	0,019**	Accepted
Indirect effect						
ATB -> INT -> SI	0,341	0,339	0,086	3,975	0,000***	Accepted
DGN -> INT -> SI	0,174	0,173	0,062	2,780	0,006**	Accepted
IGN -> INT -> SI	0,113	0,110	0,041	2,757	0,006**	Accepted
PBC -> INT -> SI	0,104	0,100	0,040	2,615	0,009**	Accepted
SN -> INT -> SI	0,088	0,081	0,036	2,449	0,015*	Accepted

Attitude (ATB) exhibited a strong positive association with Intention ($\beta = 0.634$; $p < 0.001$), supporting H1. This finding indicates that farmers who perceive goat–coffee integration as economically beneficial, environmentally sustainable, and profitable are more likely to develop stronger intentions to continue implementing it. However, Attitude did not exert a significant direct effect on Sustained Implementation (SI) ($\beta = 0.037$; $p = 0.584$), leading to the rejection of H6.

Subjective Norm (SN) showed a significant positive effect on both Intention ($\beta = 0.164$; $p < 0.05$) and Sustained Implementation (SI) ($\beta = 0.122$; $p < 0.05$), supporting H2 and H7. Although the magnitude of these associations was relatively modest, the findings suggest that social expectations from important referent groups, such as family members, extension agents, and community leaders, remain relevant in shaping both farmers' intentions and sustained implementation behaviour.

Perceived Behavioural Control (PBC) emerged as one of the most influential determinants in the model. PBC had a significant positive effect on Intention ($\beta = 0.194$; $p < 0.01$), supporting H3, and a strong positive effect on Sustained Implementation ($\beta = 0.525$; $p < 0.001$), supporting H8. Together, Intention ($\beta = 0.537$; $f^2 = 0.380$) and PBC ($\beta = 0.525$; $f^2 = 0.817$) emerged as the dominant correlates of Sustained Implementation, indicating that both motivational readiness and perceived implementation capability are central to continued implementation behaviour.

Regarding group norms, the results suggest a differentiated pattern. Injunctive Group Norm (IGN) had a positive and significant effect on Intention ($\beta = 0.211$; $p < 0.01$), supporting H4, but did not significantly influence Sustained Implementation (SI) ($\beta = 0.018$; $p = 0.783$), leading to the rejection of H9. Similarly, Descriptive Group Norm (DGN) significantly influenced Intention ($\beta = 0.323$; $p < 0.001$), supporting H5, but had no significant direct effect on Sustained Implementation ($\beta = 0.002$; $p = 0.977$), resulting in the rejection of H10. These findings suggest that observing peer behaviour and perceiving social approval primarily affect farmers' motivational orientation rather than directly translating into sustained implementation behaviour.

The absence of significant direct associations between group norms and Sustained Implementation does not diminish their theoretical relevance. Rather, these findings indicate that group norms contribute to explaining intention formation rather than directly improving behavioural prediction, thereby extending the explanatory scope of TPB within socially embedded farming contexts.

Finally, Intention exhibited a strong and highly significant effect on Sustained Implementation ($\beta = 0.537$; $p < 0.001$), supporting H11. This finding aligns with the central proposition of TPB that intention represents one of the closest behavioural antecedents of continued

implementation. Together with PBC, Intention emerged as one of the strongest correlates of Sustained Implementation, suggesting that the continuation of goat–coffee integration depends on both motivational readiness and perceived implementation capability.

Indirect effects were assessed using bootstrapping procedures to evaluate the mediating role of Intention. Given the cross-sectional nature of the data, these indirect effects should be interpreted as statistical mediation patterns rather than as evidence of causal mediation processes. As shown in Table 5, significant indirect associations through Intention were observed for Attitude, Subjective Norm, Perceived Behavioural Control, Injunctive Group Norm, and Descriptive Group Norm, supporting the role of Intention as a key intervening construct within the extended TPB framework. The strongest indirect association was observed for Attitude (β = 0.341; p < 0.001), followed by Descriptive Group Norm (β = 0.174; p < 0.01), whereas Subjective Norm demonstrated a relatively modest indirect association (β = 0.088; p < 0.05). These results suggest that attitudinal and normative factors primarily influence Sustained Implementation indirectly through intention formation, whereas Perceived Behavioural Control exhibits both indirect and substantial direct associations with Sustained Implementation.

Overall, the findings indicate that attitudinal, normative, and perceived-capability factors contribute differently to intention formation and sustained implementation behaviour, highlighting the importance of distinguishing motivational processes from behavioural continuation among existing adopters. Figure 2 summarises the significant direct and indirect relationships identified in the structural model.

Explaining intention formation in integrated goat–coffee systems

The findings provide empirical support for the applicability of the Theory of Planned Behaviour (TPB) in explaining farmers' intentions to continue implementing integrated goat–coffee farming systems. Attitude emerged as the strongest predictor of Intention, indicating that favourable

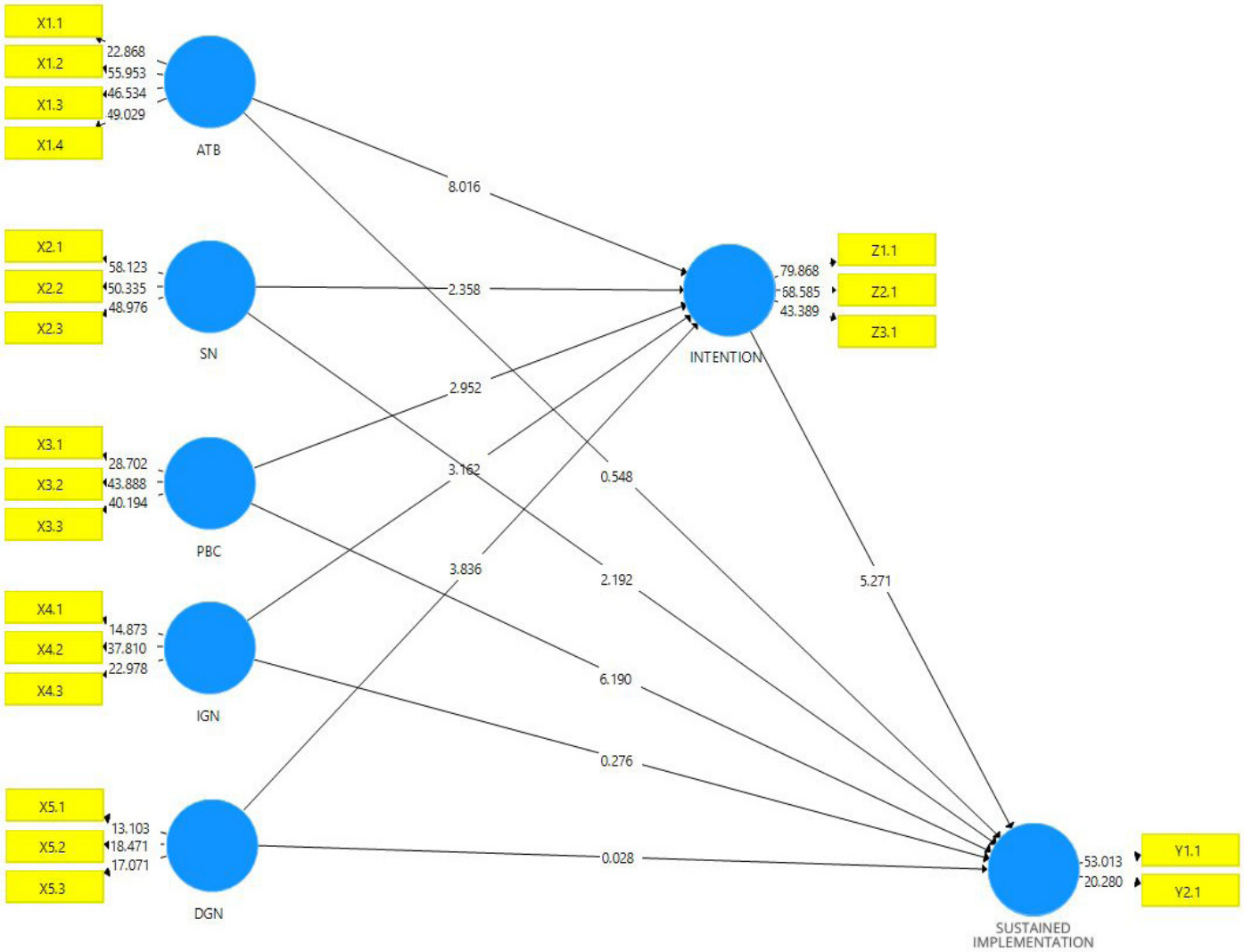

Figure 2: Sem result model.

evaluations of the integration system are closely associated with farmers' willingness to sustain its implementation. Because the attitude construct explicitly captures perceived economic and environmental benefits, this finding primarily confirms the relevance of attitudinal evaluations within the TPB framework rather than identifying a previously unrecognised behavioural mechanism. Subjective Norm, Injunctive Group Norm, and Descriptive Group Norm also demonstrated positive associations with Intention, suggesting that both institutional and social environments contribute to motivational readiness. However, the comparatively smaller coefficients of these normative constructs indicate that social influence plays a supporting rather than dominant role in intention formation. Collectively, these findings suggest that farmers' intentions are shaped by a combination of positive evaluations and normative influences, with attitudinal considerations representing the most influential correlate within the present model (Ginting *et al*., 2025; Hida *et al*., 2023; Maxiselly *et al*., 2022; FakhrHosseini *et al*., 2024).

From intention to sustained implementation

The findings indicate that Intention and Perceived Behavioural Control represent the two most important correlates of Sustained Implementation within integrated goat–coffee farming systems. While attitudinal and normative factors contribute substantially to intention formation, their direct associations with Sustained Implementation were either weak or non-significant. In contrast, both Intention and Perceived Behavioural Control demonstrated strong positive relationships with continued implementation behaviour (Timpanaro *et al*., 2023). This pattern suggests that positive evaluations and normative influences were not directly associated with Sustained Implementation after Intention and PBC were taken into account (Rezaei *et al*., 2019; Swart *et al*., 2023; Tran-Nam and Tiet, 2022). Rather than demonstrating an intention–behaviour gap, the findings highlight the importance of distinguishing motivational processes from behavioural continuation. Farmers may express strong intentions toward integrated farming, but continued implementation appears to depend on the extent to which they perceive the practice as feasible within their existing resource and management conditions (Alrawhani *et al*., 2025; Borychowski *et al*., 2025). Accordingly, the findings reinforce the TPB proposition that behavioural outcomes are influenced not only by motivational readiness but also by perceived implementation capability. In the context of integrated goat–coffee systems, both dimensions appear closely associated with sustained implementation behaviour (Duong, 2023).

Perceived behavioural control as a key correlate of sustained implementation

Perceived Behavioural Control (PBC) emerged as one of the strongest correlates of Sustained Implementation in the present study. The substantial direct association between PBC and Sustained Implementation suggests that farmers' perceptions of implementation capability, resource adequacy, and operational feasibility are closely associated with the continuation of integrated goat–coffee farming practices (Shi *et al*., 2019). Within integrated farming systems, implementation requires the coordination of multiple activities, including crop management, livestock feeding, labour allocation, and organic waste utilisation. Such operational complexity may increase the importance of perceived implementation capability alongside motivational factors (Arkorful *et al*., 2022).

Compared with the attitudinal and normative constructs, PBC exhibited one of the strongest direct associations with Sustained Implementation. This finding is consistent with the TPB proposition that behaviour is influenced not only by motivational readiness but also by perceived control over implementation conditions. From a practical perspective, the findings suggest that implementation support programmes may need to address both motivational and capability-related dimensions (Arkorful *et al*., 2022; Chen, 2025; Kabir, 2021).

Nevertheless, the PBC construct in this study primarily reflects perceived implementation capability rather than objective operational conditions. Future research may therefore benefit from incorporating more context-specific indicators, such as labour availability, fodder access, livestock management capacity, and technical support services, to further examine the operational dimensions of perceived behavioural control in integrated farming systems.

Social influence and intention formation

The findings indicate that social influence was significantly associated with Intention but not with Sustained Implementation (Liu *et al*., 2026). Injunctive Group Norm and Descriptive Group Norm were positively associated with Intention, yet neither construct exhibited a significant direct association with Sustained Implementation. This pattern suggests that social approval and peer behaviour may contribute to farmers' motivational orientation toward integrated goat–coffee farming, whereas continued implementation appears to be more closely associated with perceived capability and behavioural commitment (Rezaei *et al*., 2019; Swart *et al*., 2023).

An important theoretical contribution of the extended TPB model is that the inclusion of Injunctive and Descriptive Group Norms provides additional insight

into how social environments shape farmers' intentions. Although these constructs did not directly predict Sustained Implementation, their significant associations with Intention indicate that normative influences remain relevant during the motivational stage of behavioural decision-making. Consequently, the findings suggest that social influence helps explain why farmers intend to continue integrated farming practices, even when implementation outcomes are more strongly associated with Intention and Perceived Behavioural Control. At the same time, the absence of significant direct effects from group norms to Sustained Implementation highlights the importance of distinguishing between factors that shape behavioural motivation and those associated with behavioural continuation. Future research may further explore how different forms of social influence interact with operational conditions and implementation capability within integrated farming systems.

Conceptual and policy implications

Conceptually, this study contributes to the Theory of Planned Behaviour literature in three ways. First, the findings demonstrate that the determinants of intention formation are not necessarily identical to those associated with Sustained Implementation. This distinction contributes to TPB research by highlighting the importance of separating motivational processes from behavioural continuation in integrated farming systems. Second, extending TPB with Injunctive and Descriptive Group Norms improves the understanding of intention formation in socially embedded farming contexts, even though these normative constructs do not directly predict Sustained Implementation (Takahashi *et al*., 2020). Third, the results highlight the prominent role of Perceived Behavioural Control alongside Intention in explaining continued implementation behaviour, suggesting that perceived implementation capability represents an important correlate of behavioural continuation among existing adopters. Collectively, these findings refine the application of TPB to integrated crop–livestock systems by clarifying the distinct roles of attitudinal, normative, and capability-related factors.

From a practical perspective, the findings suggest that future implementation support programmes may need to consider both motivational and capability-related dimensions. While positive evaluations and social influences were associated with intention formation, Sustained Implementation was more closely associated with Intention and Perceived Behavioural Control. Accordingly, interventions designed to support integrated farming systems may need to complement awareness-building efforts with strategies that strengthen farmers' perceived implementation capability and operational readiness. However, because the present study did not directly measure specific structural constraints or intervention mechanisms, these implications should be interpreted cautiously and viewed as directions for future policy development rather than as direct policy prescriptions (Ehlert and Brennan, 2025; Yusuf *et al*., 2021).

Limitations and future research directions

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design limits the ability to establish temporal ordering among the constructs examined. Although the proposed relationships are theoretically grounded in the Theory of Planned Behaviour, the data do not permit causal inference. Consequently, the observed associations should be interpreted as behavioural correlates rather than as evidence of causal effects. Reverse causality also remains possible, as farmers who have already sustained implementation may subsequently report more favourable attitudes, stronger perceived behavioural control, or greater normative alignment. Longitudinal and panel-data designs would therefore be valuable for examining how intentions and implementation behaviours evolve over time.

Second, Intention and Sustained Implementation were measured within the same survey period. As a result, the study does not directly examine the temporal transition from intention formation to subsequent implementation behaviour. The findings therefore provide evidence regarding the correlates of Sustained Implementation rather than direct evidence of an intention–behaviour gap. Future studies employing repeated observations across multiple production cycles would be better positioned to investigate behavioural dynamics and implementation trajectories over time.

Third, Sustained Implementation was measured using self-reported indicators. Although contextual verification was conducted during farm visits whenever possible, the behavioural measures may still be influenced by recall bias or social desirability bias. Future research could strengthen measurement validity by combining survey responses with observational data, farm records, or other objective indicators of implementation behaviour.

Fourth, although the extended TPB framework explained a substantial proportion of variance in Intention and Sustained Implementation, several structural and contextual factors were not explicitly modelled. Variables such as market conditions, institutional support, resource availability, and production risks may interact with psychological determinants and contribute to implementation outcomes. Future studies that integrate

behavioural and structural dimensions may provide a more comprehensive understanding of implementation processes in integrated farming systems.

Finally, the study was conducted among existing adopters of integrated goat–coffee farming systems in Malang Regency, East Java. The findings therefore primarily reflect behavioural variation among established adopters operating within a specific socio-economic and institutional context. Although the results contribute to broader discussions on integrated farming systems, caution is warranted when extending the findings to different regions, production systems, or farmer populations. Nevertheless, the findings provide evidence that sustained implementation in integrated farming systems is associated with a distinct combination of motivational, normative, and perceived-capability factors, thereby extending the application of TPB beyond initial adoption decisions.

CONCLUSION

This study provides empirical evidence that sustained implementation of integrated goat–coffee farming systems is associated with a combination of attitudinal, normative, and perceived-capability factors. Extending the Theory of Planned Behaviour (TPB), the findings show that Attitude, Subjective Norm, Injunctive Group Norm, Descriptive Group Norm, and Perceived Behavioural Control contribute to intention formation, although their relative importance differs substantially across constructs. In contrast, Sustained Implementation is most strongly associated with Intention and Perceived Behavioural Control.

The findings highlight the importance of distinguishing between intention formation and behavioural continuation. While attitudinal and normative factors contribute to farmers' motivational readiness, their influence on Sustained Implementation operates primarily through Intention rather than through direct behavioural associations. Continued implementation appears to depend not only on farmers' willingness to maintain integrated farming practices but also on their perceived capability to do so.

From a theoretical perspective, this study extends TPB by demonstrating that the determinants of intention formation are not necessarily identical to the determinants of sustained implementation among existing adopters. The findings therefore highlight the value of distinguishing motivational antecedents from behavioural continuation when examining long-term implementation of integrated crop–livestock systems.

From a practical perspective, the findings suggest that implementation support programmes may benefit from addressing both motivational and capability-related dimensions. Interventions such as practical training, participatory extension, and farmer-to-farmer learning may help create conditions that strengthen farmers' perceived implementation capability and readiness. However, because the present study measured perceived rather than objective capability and employed a cross-sectional design, these implications should be interpreted cautiously and not as evidence of causal policy effects.

Overall, the study contributes to the growing literature on agricultural sustainability by demonstrating that sustained implementation in integrated farming systems is associated with both motivational readiness and perceived implementation capability. The findings suggest that understanding why farmers continue, rather than merely adopt, integrated practices represents an important direction for future behavioural research in agriculture.

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NOVELTY STATEMENT

This study advances the literature by addressing sustained implementation in integrated crop–livestock systems, specifically within goat–coffee farming. It extends TPB by incorporating injunctive and descriptive group norms and by explicitly distinguishing between motivational drivers and perceived enabling conditions. The study demonstrates that while attitudes and social norms shape intention, sustained implementation is primarily associated with perceived behavioural control, highlighting the critical role of perceived capability in translating intention into continued implementation.

AUTHOR'S CONTRIBUTION

Rofiatin Annisa: Conceptualisation, methodology, data curation, writing original draft. Budi Hartono: Supervision, methodology, writing review and editing. Jaisy Aghniarahim Putritamara: Conceptualisation, supervision, review and editing. Irida Novianti: Validation, methodology, writing review and editing. Eko Nugroho: Investigation, data curation, visualisation, writing review and editing.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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