

SUSTAINABLE COFFEE PRODUCTION: THE EFFECT OF SOCIAL NORMS, TRUSTS AND NETWORKS ON COFFEE FARMERS' ADOPTION BEHAVIOR IN LAMPUNG PROVINCE, INDONESIA

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Abstract

Sustainable coffee production is critical for ecological balance and livelihood resilience, yet adoption rates among smallholders remain variable. Although social capital is acknowledged as a key driver of agricultural sustainability, the distinct impacts of its constituent dimension's norms, networks, and trust are insufficiently understood. This study aims to elucidate the differential influence of these social capital dimensions on sustainable production behavior among coffee farmers in Lampung Province, Indonesia. Employing a cross-sectional quantitative explanatory design, data were gathered via structured surveys from 250 coffee farmers selected through purposive sampling over a two-month period. Measurement instruments adapted from established scales underwent rigorous validation. The structural model was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with bootstrapping to ensure robustness. Findings demonstrate that social norms and social networks exert significant positive effects on farmers' adoption of sustainable coffee practices. Conversely, social trust exhibits no direct statistical influence on behavior. The structural model explains a substantial proportion of behavioral variance and demonstrates adequate predictive relevance. This research offers novelty by empirically disentangling the multidimensional nature of social capital in agricultural contexts, challenging the prevailing assumption that all dimensions uniformly drive sustainability outcomes. Theoretically, it advances social capital literature by validating dimension-specific effects within agrarian settings. Practically, implications suggest that extension programs and policymakers should prioritize norm activation through respected community figures and strengthen peer-to-peer knowledge exchange networks. These levers prove more effective for behavioral change than generalized trust-building alone.

Keywords: Coffee Farmers', SEM, Social Capital, Sustainable Production Consumption



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INTRODUCTION

Sustainable coffee production is increasingly acknowledged as vital for balancing environmental integrity, economic sustainability, and social well-being within global agricultural systems. The coffee industry links international commodity markets with the livelihoods of millions of smallholder farmers, yet it remains vulnerable to climate change, socio-economic instability, and evolving consumer expectations for ethical products. Research shows that initiatives such as organic certification and corporate sustainability programs can strengthen environmental stewardship and improve producer outcomes, particularly among smallholder communities where access to resources and markets is limited (Blanco-Pacheco et al., 2025). At the farmer level, sustainable production depends not only on access to technological innovations and ecological knowledge but also on social structures that support information exchange, trust, and collective action. Social capital defined as the networks, norms, and trust embedded within farmer communities has been identified as a critical facilitator of innovation adoption and cooperative engagement. Studies in coffee systems suggest that social capital supports partnerships between farmers and stakeholders by enhancing trust, ongoing cooperative activities, and sustained connections that are essential for implementing new production practices and accessing external support (Haryono et al., 2024). From an innovation perspective, adaptation to climate change in coffee systems requires not only technical solutions but also strong social-institutional transformations, where social capital plays a crucial role as a foundation for knowledge networks and social support for smallholder farmers (Verburg et al., 2019).

In addition, understanding the environmental impacts of production processes is essential for assessing sustainability. Detailed life cycle assessment (LCA) of dry processing methods in specialty coffee production revealed that the choice of processing technique significantly influences greenhouse gas emissions (global warming potential) and other environmental impacts, highlighting that sustainable coffee production must consider impacts throughout the value chain, from farm to processing (Irawan et al., 2024). However, barriers to the adoption of sustainable agricultural practices persist. A taxonomy of such barriers shows that obstacles occur at various stages of coffee farming from nursery and planting to harvesting and include factors such as limited access to resources, weak institutional support, and inadequate extension services, all of which can constrain farmers' ability to adopt sustainable practices. Understanding these barriers is crucial for designing interventions that enhance adoption outcomes (Akenroye et al., 2021a). Social networks and capital help farmers embrace sustainable agricultural practices and climate change adaptation techniques by improving knowledge sharing, building trust, and lowering risk aversion. Participation in these networks improves the flow of information on new technology, as seen by improved adoption of conservation agriculture and climate-smart practices, particularly in smallholder contexts (Mathanda et al., 2025).

Despite the recognized importance of social capital in supporting sustainable agriculture, its specific role in shaping farmers' adoption behavior of sustainable coffee practices especially in developing country settings remains underexplored. This research therefore investigates how social capital influences the adoption of sustainable production practices among smallholder coffee farmers in Tanjung Raja, North Lampung, with the aim of illuminating mechanisms that enable or constrain adoption decisions in pursuit of both environmental sustainability and farmer livelihoods.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Social Networks and Sustainable Production Behavior

Social networks (SOCNET) constitute the structural foundation of social capital within agricultural communities, representing the patterns of connections and interactions among actors that facilitate resource exchange, knowledge diffusion, and collective action (Hernández-Medina et al., 2025; Li et al., 2023). In the context of coffee farming, social networks encompass formal linkages (e.g., cooperatives, certification bodies, extension services) and informal connections (e.g., peer farmers, family networks, community groups) that collectively shape farmers' access to information, technology, and market opportunities (Haryono et al., 2024; Snider, Afonso Gallegos, et al., 2017). These networks function as critical conduits for disseminating knowledge about sustainable agricultural practices, enabling farmers to observe, discuss, and adopt innovations that enhance environmental stewardship and production efficiency (Chang et al., 2025; Günther et al., 2025).

The relationship between social networks and sustainable production behavior (SPB) is well-documented in agricultural literature. Farmers embedded in dense, diverse networks demonstrate higher adoption rates of sustainable practices such as soil conservation, integrated pest management, and agroforestry systems (Bro et al., 2019; Kudama et al., 2021). Network connectivity enables access to technical knowledge about Good Agricultural Practices (GAP), climate-smart techniques, and certification requirements that directly inform sustainable production decisions (Harahap et al., 2025; Istiqomah et al., 2024). Furthermore, participation in farmer groups and cooperatives key structural manifestations of social networks provides institutional support for implementing sustainable practices through shared resources, collective bargaining power, and access to premium markets (Folch & Planas, 2019; Méndez et al., 2010).

Empirical evidence from coffee-producing regions substantiates this relationship. In Ethiopia, farmers with stronger network ties to extension agents and fellow producers exhibited significantly higher adoption of bundled sustainable practices, including shade management and organic fertilization (Adane & Bewket, 2022; Kudama et al., 2021). Similarly, Indonesian coffee farmers participating in robust farmer groups demonstrated enhanced capacity to implement sustainable production standards through knowledge sharing and collective learning (Afrianto et al., 2024; Kurniawan et al., 2021). This pattern extends beyond coffee systems to broader agricultural landscapes in Indonesia, where social networks have proven instrumental in facilitating sustainable land management practices. (Wulandari et al., 2025) documented that farmers engaged in dense social networks following peatland fires demonstrated significantly higher adoption of sustainable restoration techniques, including water table management and native vegetation rehabilitation, compared to isolated farmers. These findings collectively underscore that social network functions as critical infrastructure for sustainable practice diffusion across diverse agroecological contexts. By reducing information asymmetries, lowering transaction costs, and enabling collective problem-solving, robust social networks directly influence farmers' behavioral choices toward sustainable production (De Felice et al., 2025; Nuraisyah et al., 2025).

The mechanism linking social networks to SPB operates through enhanced information access and social learning. When farmers maintain active connections within their communities, they gain exposure to successful sustainable practices implemented by peers, reducing perceived risks and increasing adoption confidence (Jara-Rojas et al., 2020; Rocha et al., 2025)). Network participation also facilitates access to certification schemes and sustainability standards that create market incentives for environmentally responsible production (Berihun & Gutema, 2025; Snider, Afonso Gallegos, et al., 2017), the density, diversity, and quality of social networks directly shape farmers' capacity and motivation to engage in sustainable production behaviors. Therefore, the following hypothesis is proposed:

H1: Social networks positively influence sustainable production behavior among coffee farmers.

Social Trust and Sustainable Production Behavior

Social trust (STRUST) represents the cognitive and affective expectation that network partners will act reliably, honestly, and with mutual benefit in their interactions (Suárez et al., 2021; Yazdanpanah et al., 2025). In agricultural contexts, trust manifests as farmers' confidence in the credibility of information sources, the reliability of institutional partners, and the reciprocity of peer relationships (Li et al., 2023; Prayitno et al., 2025). Trust serves as a critical lubricant for sustainable agricultural development, reducing transaction costs, enabling risk-sharing arrangements, and facilitating collective action toward environmental goals (Chang et al., 2025; Kitano, 2025). Within coffee value chains, trust operates at multiple levels: interpersonal trust among farmers, institutional trust in cooperatives and certification bodies, and systemic trust in market mechanisms that reward sustainability (Bilfield et al., 2020; Edelman et al., 2022).

The direct relationship between social trust and sustainable production behavior is grounded in risk perception theory and institutional economics. Sustainable agricultural practices often require upfront investments with delayed or uncertain returns, creating adoption barriers rooted in risk aversion (Bro et al., 2019; Nguyen & Drakou, 2021). Trust mitigates these barriers by reducing perceived uncertainty regarding practice outcomes, market rewards, and institutional support (Günther et al., 2025; Prayitno et al., 2025). When farmers trust extension agents, they are more likely to adopt recommended sustainable techniques; when they trust cooperatives, they invest in certification schemes;

and when they trust peer farmers, they experiment with novel agroecological approaches (Harahap et al., 2025; Snider et al., 2017).

Empirical research across coffee-producing regions demonstrates trust's direct influence on sustainable practices. In Costa Rica, farmers with higher trust in cooperative leadership showed significantly greater adoption of certified sustainable practices, including water conservation and biodiversity protection (Snider et al., 2016; Snider, Afonso Gallegos, et al., 2017). Ethiopian smallholders with stronger trust in value chain actors demonstrated enhanced willingness to implement climate adaptation measures despite short-term costs (Adane & Bewket, 2022; Teshome et al., 2016). Similarly, Indonesian coffee farmers exhibiting higher institutional trust were more likely to comply with organic production standards and invest in long-term soil health improvements (Afrianto et al., 2024; Siregar et al., 2024). Trust functions as a psychological enabler that transforms awareness of sustainable practices into actual behavioral adoption by reducing perceived risks and enhancing confidence in expected benefits (Li et al., 2023; Yazdanpanah et al., 2025).

The mechanism operates through three pathways: (1) trust enhances information credibility, making sustainability recommendations more persuasive; (2) trust facilitates resource pooling for collective sustainable initiatives (e.g., shared composting facilities); and (3) trust enables long-term planning horizons necessary for practices with delayed returns. (Haryono et al., 2024; Nisak et al., 2025). Consequently, social trust directly shapes farmers' behavioral intentions and actions toward sustainable production without requiring intermediate cognitive processes. Therefore, the following hypothesis is proposed:

H₂: Social trust positively influences sustainable production behavior among coffee farmers.

Social Norms and Sustainable Production Behavior

Social norms (SNORM) constitute the shared expectations, standards, and informal rules that guide behavior within a community, operating through social approval, disapproval, and identity reinforcement (Akenroye et al., 2021b; Nabillah & Fawzi, 2025). In agricultural communities, norms emerge around production practices, environmental stewardship, and resource management, creating powerful behavioral incentives that often surpass formal regulations or economic incentives (Folch & Planas, 2019; Kairiza et al., 2023). Norms function through two mechanisms: descriptive norms (perceptions of what others commonly do) and injunctive norms (perceptions of what others approve or disapprove) (Cialdini et al., 1990), 1990, as applied in agricultural contexts by Teshome et al., 2016; Suárez et al., 2021). Within coffee farming communities, sustainability-related norms develop around practices such as shade tree preservation, chemical input reduction, water conservation, and waste management behaviors that become "the way we do things here" through social reinforcement (Méndez et al., 2010; Morel et al., 2019).

The direct influence of social norms on sustainable production behavior is grounded in social identity theory and normative social influence frameworks. Farmers derive part of their identity from community membership, creating intrinsic motivation to conform to group expectations regarding appropriate agricultural practices (Nabillah & Fawzi, 2025; Suárez et al., 2021). When sustainable practices become normative within a community, non-adoption carries social costs including reputation damage, exclusion from information networks, and loss of community standing (Akenroye et al., 2021c; Kairiza et al., 2023). These social sanctions operate alongside and sometimes more powerfully than economic incentives in shaping behavioral choices (Folch & Planas, 2019; Thom et al., 2025).

Empirical evidence demonstrates norms' direct behavioral impact across coffee-producing regions. In Chiapas, Mexico, communities where organic production became normative exhibited near-universal adoption rates regardless of individual economic calculations, as farmers conformed to collective expectations (Folch & Planas, 2019; Méndez et al., 2010). Colombian coffee growers in communities with strong conservation norms maintained higher shade tree densities and biodiversity despite market pressures for intensified production (Morel et al., 2019; Suárez et al., 2021). Similarly, Ethiopian farmers in communities where soil conservation practices were socially expected demonstrated significantly higher adoption rates than those in communities without such norms, even when controlling for economic factors (Adane & Bewket, 2022; Teshome et al., 2016). These patterns reflect norms' capacity to create self-reinforcing cycles of sustainable behavior through social reinforcement mechanisms (Rocha et al., 2025; Siregar et al., 2024).

The mechanism operates through identity alignment and social monitoring. Farmers internalize community norms as part of their self-concept, making sustainable practices feel intrinsically "right"

rather than merely instrumentally beneficial (Nabillah & Fawzi, 2025). Simultaneously, visible farming practices enable community monitoring, creating accountability that reinforces norm compliance (Kairiza et al., 2023). When sustainability becomes normative, farmers adopt practices not primarily for economic gain but to maintain social standing and community belonging to a direct behavioral pathway independent of mediating cognitive processes (Akenroye et al., 2021c; Thom et al., 2025). Therefore, the following hypothesis is proposed:

H3: Social norms positively influence sustainable production behavior among coffee farmers.

Integrated Framework

The theoretical framework positions social networks, social trust, and social norms as three distinct yet complementary dimensions of social capital that directly influence sustainable production behavior in coffee farming systems (Figure 1). Rather than operating sequentially through mediating pathways, these constructs exert independent yet synergistic effects on farmers' behavioral choices. Social networks provide structural channels for information and resource exchange; social trust reduces perceived risks and enhances cooperation; and social norms create behavioral expectations reinforced through social approval mechanisms. Together, they constitute a robust social infrastructure that enables and motivates sustainable agricultural practices across diverse coffee-producing contexts from smallholder systems in Ethiopia and Indonesia to cooperative-based models in Latin America (Berihun & Gutema, 2025; De Felice et al., 2025).

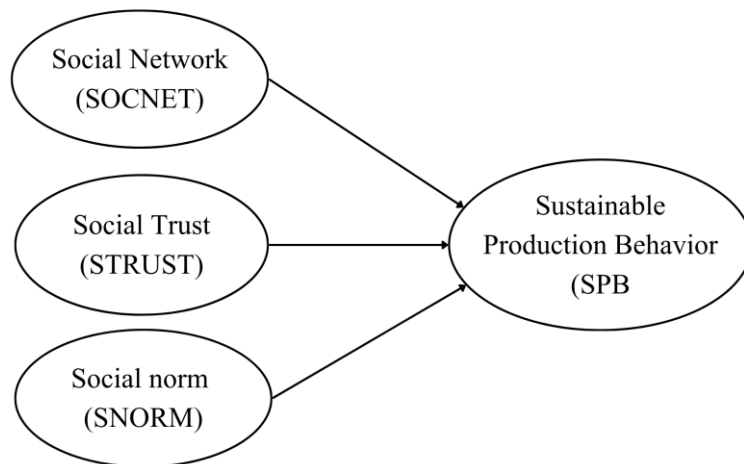


Figure 1. Theoretical framework

This direct-effects approach aligns with contemporary social capital theory that recognizes multiple pathways through which social resources influence behavior (Morrow & Scorgie-Porter, 2017; Woolcock, 2001) while avoiding overly complex mediation assumptions that may obscure practical intervention points for sustainability programs. The framework acknowledges contextual variation geographic, institutional, and cultural without requiring explicit moderation testing, recognizing that the strength of each relationship may vary across settings while maintaining directional consistency (Chang et al., 2025; Li et al., 2023). This parsimonious yet theoretically grounded model provides a foundation for understanding how social dynamics directly shape sustainable production behaviors in global coffee value chains, with implications for designing community-based interventions that strengthen social infrastructure to advance agricultural sustainability.

RESEARCH METHOD

We conducted a quantitative explanatory research design conducted in Tanjung Raja District, North Lampung Regency, Indonesia, over a two-month period. The main objective was to examine the role of social capital in influencing farmers' adoption behavior of sustainable coffee production practices. The research subjects consisted of 250 smallholder coffee farmers selected through purposive

sampling from active farmer groups. Data was collected in two stages to reduce common method bias: the first stage measured social capital and control variables, while the second stage measured adoption behavior. The study used a structured questionnaire with five-point Likert scale items adapted from established instruments and adjusted to the coffee farming context. Data collection was carried out through direct field distribution with the assistance of farmer group facilitators and agricultural extension officers. Data analysis involved SPSS for data entry, descriptive statistics, and preliminary reliability testing, and SmartPLS for measurement and structural model evaluation using PLS-SEM. Validity and reliability were assessed through AVE, Composite Reliability, Cronbach's Alpha, and HTMT, while hypothesis testing used bootstrapping of path coefficients and R^2 evaluation. Harman's Single Factor Test and VIF values were applied to detect potential common method bias and multicollinearity issues.

Research Design

This study employed a quantitative explanatory research design with a survey approach to examine the role of social capital in farmers' adoption of sustainable coffee production practices. The methodology comprised three sequential phases: instrument development and validation, data collection, and data analysis ensuring a rigorous and systematic evaluation of the proposed theoretical model.

Research Target/Subject

The research subjects were smallholder coffee farmers located in Tanjung Raja District, North Lampung Regency, Indonesia. The area was selected due to its significance as a coffee-producing region confronting sustainability challenges including the effects of climate change, reduced land productivity, and restricted market access as well as its status as the fourth-largest contributor to Lampung's coffee production.

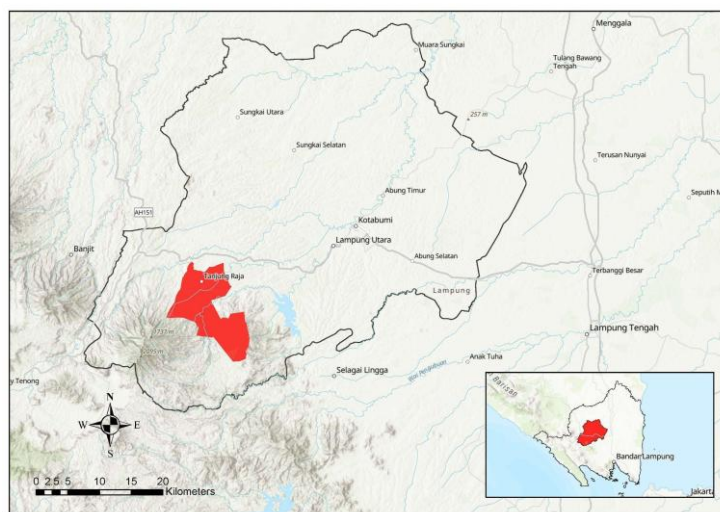


Figure 2. Map of the study area in Tanjung Raja District, North Lampung Regency, Indonesia.

A total of 250 farmers were selected as respondents using purposive sampling method from several active farmer groups. The selection criteria included:

- Farmers who have actively managed coffee farms for at least the last two years
- Membership or involvement in farmer groups or agricultural communities
- Exposure to information or training related to sustainable agricultural practices.

Research Procedure

To test the hypotheses, we employed a purposive sampling and collected data over a two-month period. A total of 250 questionnaires were distributed directly to coffee farmers with the assistance of trained enumerators. The instrument comprised measurement items for the dependent variable farmers' adoption behavior of sustainable coffee practices. To capture behavioral changes over time, the same respondents completed the questionnaire in two waves, with responses matched across waves using a unique respondent code. After screening out incomplete questionnaires and those completed in an

unrealistically short duration, 250 valid responses were retained for analysis. Participation in both waves was voluntary, and respondents were informed that the data would be used exclusively for academic research purposes.

Instruments, and Data Collection Techniques

The measurement instruments were developed based on established scales from prior literature and adapted to the context of sustainable coffee farming, good agricultural practices (GAP), and agroforestry systems in Lampung Province. Data were collected through offline using questionnaire. The questionnaire comprised two sections: (1) demographic and farm characteristics, including respondents' age, gender, income level, land size, and cultivation practices; and (2) measurement items for the study constructs. All construct items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scales were carefully adapted from validated instruments in previous studies and contextualized to reflect the realities of coffee farming in the research area (table 1). A purposive sampling technique was employed to select coffee farmers in Lampung Province who actively engaged in coffee cultivation and had exposure to sustainable farming initiatives. This non-probability approach ensured that the sample comprised information-rich respondents capable of providing meaningful insights into sustainable production practices. This study involved a sample of 250 respondents, considering that a sample size between 160 and 300 valid observations is almost always optimal for multivariate statistical analysis techniques. This sample size is neither small nor large, thus minimizing the potential for influencing the study's conclusions, such as Type I and Type II errors (Mumtaz et al., 2020).

Table 1. Assessment tools and rating systems for main constructs

Construct	Codes	Indicators
Social Network Adapted from (Bray et al., 2023; Haryono et al., 2024; Wulandari & Inoue, 2018)	SOCNET1	I regularly participate in coffee grower groups and cooperatives.
	SOCNET2	I maintain constant communication with buyers/regular consumers.
	SOCNET3	I am a member of a coffee farmer group.
	SOCNET4	I have access to agricultural extension personnel and coffee experts.
	SOCNET5	I frequently share information with other coffee business actors.
	SOCNET6	I frequently share information with other coffee business actors.
Social Trust Adapted from Putnam (2000); (Faila Sophia Hartatri et al., 2019; Haryono et al., 2024)	STRUST1	I trust my fellow coffee farmers.
	STRUST2	I believe that the information offered in farmer groups is reliable.
	STRUST3	I believe that farmer groups and cooperatives work for the benefit of their members.
	STRUST4	I believe that coffee purchasers will respect price agreements.
	STRUST5	I feel that the government favors coffee plantation development.
	STRUST6	I trust that my fellow farmers will not disadvantage me.
	STRUST7	I believe the coffee purchasers will not disadvantage me.
Social Norm Adapted from (Cialdini et al., 1990; Ren et al., 2022; Zhang et al., 2023)	SNORM1	I comply with quality standards in coffee production and processing.
	SNORM2	I use sustainable approaches (social forestry/sustainable agriculture) in coffee production.

Construct	Codes	Indicators
Farmers' Sustainable Behavior Adapted from (Arifin, 2022; Elkington, 1998; Rizka Esty Wulandari, Bustanul Arifin & Jurusan, 2019)	SNORM3	I am devoted to fair pricing agreements.
	SNORM4	I observe the regulations of agricultural groups/associations.
	SNORM5	I take part in social/community activities of the coffee community.
	FSB1	I regularly record all expenses and income from my coffee farming business.
	FSB2	I have prepared an annual production plan.
	FSB3	I assess expenditures and income before making company decisions.
	FSB4	I optimize the usage of agriculture inputs (fertilizers, insecticides) based on needs.
	FSB5	I utilize technology to boost production volume.
	FSB6	I have contracts or sales agreements with regular customers.
	FSB7	I regularly seek information about coffee prices and marketplaces.
	FSB8	I pay workers according to regional minimal norms.
	FSB9	I offer workplace safety equipment to workers.
	FSB10	I offer periodic occupational safety training.
	FSB11	I actively participate in farmer groups.
	FSB12	I share my knowledge and experience with other farmers.
	FSB13	I engage women in coffee cultivation decision-making.
	FSB14	I provide equal opportunity for female employees.
	FSB15	I use soil conservation measures (terracing, rorak/contour trenches, etc.).
	FSB16	I utilize an effective irrigation system.
	FSB17	I convert coffee husk waste into organic fertilizer.
	FSB18	I own a wastewater treatment system.
FSB19	I keep natural shade trees (e.g., durian, stink bean, banana, dogfruit, and lamtoro) in my coffee plantation.	
FSB20	I do not use pesticides that are hazardous to pollinators.	
FSB21	I collect only ripe red coffee cherries ("selective picking").	

Data were analyzed using SPSS and SmartPLS 4. SPSS was used for data entry, descriptive statistics, and preliminary reliability testing, while SmartPLS was applied to assess the measurement and structural models through PLS-SEM. SmartPLS is used to analyze SEM because structural equation modeling (SEM) is a multivariate analysis method that allows researchers to empirically evaluate a theoretical model based on structural correlations that are usually operated by several indicators. Scholars can examine structural consistency using several estimators, which differ in how they statistically relate to structure and model (Hair et al., 2025). Convergent validity was evaluated using AVE (> 0.5), reliability through Composite Reliability and Cronbach's Alpha (> 0.7), and discriminant validity using discriminant validity (Fornell-Larcker criterion, HTMT ratio). Multicollinearity was

checked with VIF values (< 5). The structural model was then tested using PLS-SEM with a bootstrapping procedure (5000 samples) to assess the significance of direct effects (H1, H2, H3), with 95% bias-corrected confidence intervals. Bootstrapping of path coefficients, and R^2 values were used to assess explanatory power.

RESULTS AND DISCUSSION

The demographic and operational profile of coffee farmers in the study (table 2) reveals a workforce that is predominantly mature, experienced, and independently managed. In terms of age distribution, the majority of farmers fall within the mature working-age group of 41 to 56 years (40.8%), followed by those aged 25 to 40 years (36.0%), indicating that the sector is largely sustained by individuals in their productive years. Gender representation shows a significant male dominance at 75.6%, although female participation remains notable at 24.4%. Regarding land tenure, a strong sense of autonomy characterizes the farming community, with 86.4% of respondents cultivating their own land. Only a small proportion operate under sharecropping arrangements (10.0%) or leased land (2.8%). In terms of farm scale, the most common landholding size ranges from 1 to 2 hectares (39.2%), followed by plots between 0.5 and 1 hectare (29.2%), reflecting a prevalence of smallholder farming systems. Furthermore, the farmers exhibit extensive experience in coffee cultivation, with the largest group having farmed for 31 to 40 years (28.8%), complemented by substantial shares in the 21–30 year (26.8%) and 41–50 year (21.6%) categories. Collectively, these characteristics illustrate that coffee farming is not merely a temporary occupation but a long-term, generational profession deeply rooted in the livelihoods of these agricultural practitioners.

Table 2. Characteristics of respondent

Characteristic	Frequency	Percentage (%)
Age		
25-40	90	36.0
41-56	102	40.8
57-72	51	20.4
73-87	7	2.8
Gender		
Male	189	75.6
Female	61	24.4
Land Ownership Status		
Right of Ownership	216	86.4
Rental Right	7	2.8
Profit-Sharing System	25	10.0
Right to Use	2	.8
Land Area		
< 0,5 ha	29	11.6
0,5 - 1 ha	73	29.2
1- 2 ha	98	39.2
> 2 ha	50	20.0
Years of Coffee Farming Experience		
1- 2 tahun	22	8.8
2-3 tahun	35	14.0
3-4 tahun	66	26.4
4-5 tahun	72	28.8
5-6 tahun	54	21.6
>6 tahun	1	0.4

Measurement Model Assessment, Construct Reliability and Validity

The assessment of construct validity through factor loadings (table 3) reveals heterogeneous indicator performance across the measured constructs. The subjective norm (SNORM) construct demonstrates robust validity, with all indicators exhibiting loadings between 0.682 and 0.765 exceeding the commonly accepted threshold of 0.70 for well-established constructs (Hair et al., 2019b, 2019a), while remaining above the minimum criterion of 0.50 for newly developed scales (Gefen et al., 2000). Similarly, the trust in stakeholders (STRUST) construct shows strong convergent validity, with loadings ranging from 0.566 to 0.784; notably, the STRUST3 indicator achieves an excellent loading of 0.784. The social network (SOCNET) construct also satisfies validity requirements, with loadings spanning 0.530 (SOCNET2) to 0.804 (SOCNET1), indicating adequate though variable representational power across its items.

Table 3. Loading Factors

	SNORM	SOCNET	SPB	STRUST
SNORM1	0.74			
SNORM2	0.716			
SNORM3	0.682			
SNORM4	0.765			
SNORM5	0.684			
SOCNET1		0.804		
SOCNET2		0.53		
SOCNET3		0.788		
SOCNET4		0.625		
SOCNET5		0.574		
SOCNET6		0.662		
SPB1			0.655	
SPB10			0.569	
SPB11			0.521	
SPB12			0.453	
SPB13			0.297	
SPB14			0.442	
SPB15			0.639	
SPB16			0.556	
SPB17			0.54	
SPB18			0.404	
SPB19			0.227	
SPB2			0.639	
SPB20			0.241	
SPB21			0.225	
SPB3			0.64	
SPB4			0.569	
SPB5			0.65	
SPB6			0.182	
SPB7			0.603	
SPB8			0.615	
SPB9			0.545	
STRUST1				0.726
STRUST2				0.765
STRUST3				0.784

	SNORM	SOCNET	SPB	STRUST
STRUST4				0.66
STRUST5				0.566
STRUST6				0.699
STRUST7				0.68

In contrast, the sustainable practice behavior (SPB) construct exhibits considerable psychometric weakness. While two indicators SPB1 (0.655) and SPB5 (0.650) approach acceptable thresholds, five items demonstrate critically low loadings: SPB6 (0.182), SPB21 (0.225), SPB19 (0.227), SPB20 (0.241), and SPB13 (0.297). These values fall substantially below the conservative 0.70 benchmark and even beneath the lenient 0.50 minimum, suggesting these indicators lack sufficient correlation with the underlying latent construct. Such weak loadings may introduce measurement error and attenuate structural path estimates (Brown, 2015). Consequently, to enhance the model's psychometric rigor and theoretical coherence, the removal of these underperforming SPB indicators is recommended prior to proceeding with structural equation modeling. This refinement would strengthen the overall measurement model and improve the validity of subsequent hypothesis testing.

Discriminant Validity

Discriminant validity in this study was assessed using two criteria: the Fornell–Larcker criterion and the heterotrait–monotrait ratio (HTMT), in accordance with the recommendations (Henseler et al., 2016). These assessments were conducted to ensure that each construct in the research model is empirically distinct and statistically different from other constructs (Hair Jr et al, 2021).

Fornell Larcker Criterion

Table 4. Fornell Larcker Criterion

	SNORM	SOCNET	SPB	STRUST
SNORM	0,718			
SOCNET	0,632	0,672		
SPB	0,680	0,684	0,511	
STRUST	0,701	0,529	0,517	0,700

As shown in table 4, the Fornell–Larcker criterion was satisfied for all constructs. Specifically, the square root of the Average Variance Extracted (AVE) for each construct displayed on the diagonal (SNORM = 0.718; SOCNET = 0.672; SPB = 0.511; STRUST = 0.700) exceeds its highest correlation with any other construct in the model (off-diagonal values). This pattern confirms that each construct explains more variance in its own indicators than in the indicators of other constructs, thereby demonstrating adequate discriminant validity. Consequently, all constructs in the research model are empirically distinct and suitable for further structural analysis

Heterotrait Monotrait Ratio (HTMT)

Discriminant validity was further assessed using the heterotrait–monotrait ratio (HTMT) criterion. Following (Henseler et al., 2016), a threshold value of 0.90 was applied, wherein HTMT ratios below this cutoff indicate adequate discriminant validity.

Table 5. Heterotrait Monotrait Ratio (HTMT)

	SNORM	SOCNET	SPB	STRUST
SNORM				
SOCNET	0,838			
SPB	0,783	0,799		
STRUST	0,872	0,676	0,593	

As presented in the table 5 above, all pairwise HTMT values fall below the critical threshold: SNORM–SOCNET = 0.838, SNORM–SPB = 0.783, SNORM–STRUST = 0.872, SOCNET–SPB = 0.799, SOCNET–STRUST = 0.676, and SPB–STRUST = 0.593. Since all values satisfy the < 0.90 criterion, discriminant validity is confirmed for all construct pairs. Consequently, the measurement model demonstrates that each construct is empirically distinct, supporting its appropriateness for subsequent structural equation modeling.

Structural model assessment

R Square (R²)

Table 6. R Square (R²)

	R Square	R Square Adjusted
SPB	0,570	0,565

The R² assessment results (table 6) indicate that the structural model explains 57.0% of the variance in sustainable production behavior (SPB), with an R² value of 0.570 (adjusted R² = 0.565). This implies that the independent variables social norms (SNORM), social networks (SOCNET), and social trust (STRUST) collectively account for a substantial portion of the variability in SPB, while the remaining 43% is attributable to factors external to the model. According to (Hair et al., 2019b), an R² value of 0.570 falls within the moderate to "substantial" range of explanatory power in PLS-SEM (where 0.25 = weak, 0.50 = moderate, and 0.75 = substantial). Therefore, the structural model demonstrates adequate predictive relevance for SPB.

Q Square (Q²)

Table 6. Q Square (Q²) test

	SSO	SSE	Q ² (=1-SSE/SSO)
SNORM	1250.000	1250.000	
SOCNET	1500.000	1500.000	
SPB	5250.000	4559.348	0.132
STRUST	1750.000	1750.000	

Predictive relevance of the structural model was assessed using the Stone-Geisser Q² blindfolding procedure. This technique evaluates whether the model can accurately predict omitted data points for endogenous constructs. Following Hair et al. (2021), a Q² value greater than zero (Q² > 0) indicates adequate predictive relevance.

As shown in the table 6, the endogenous construct sustainable production behavior (SPB) yielded a Q² value of 0.132 (> 0), confirming the model's predictive relevance for this variable. In contrast, the exogenous constructs (SNORM, SOCNET, and STRUST) do not produce Q² values, as they serve as predictors rather than predicted variables in the structural model. Overall, the positive Q² result for SPB demonstrates that the research model possesses sufficient predictive capability for subsequent analysis and interpretation.

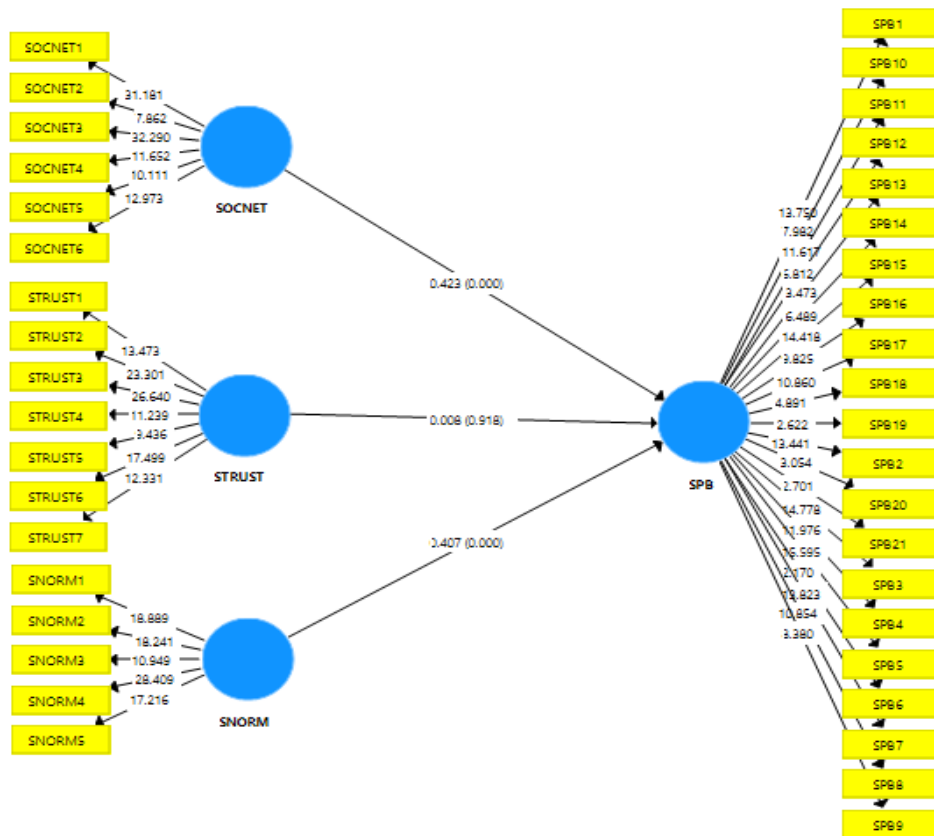


Figure 3. Estimated structural equation model.

Hypothesis testing

The structural model was tested using PLS-SEM in SmartPLS 4.0, with a bootstrapping procedure (5000 samples) to assess the significance of path coefficients for direct effect hypotheses (H1, H2, H3). SmartPLS 4.0 was selected for its advanced capabilities in PLS-SEM analysis. The results, presented in Table 3, show that two effects are significant ($p < 0.05$), supporting two hypotheses namely Hypothesis 1 (social Norm [SNORM] \rightarrow Sustainable Production behavior [SPB], path coefficient (β) = 0,423, T-statistic = 5,669, p-values sebesar 0,000). Similarly, Hypothesis 2 (social networks [SOCNET] \rightarrow Sustainable Production behavior [SPB], path coefficient (β) = 0,407, T-statistic = 5,097, p-values sebesar 0,000). Hypothesis 3 assessed Social trust (STRUST) on Sustainable Production behavior (SPB), but the results were not statistically significant (path coefficient = 0.008, T-statistic = 0.103, p-value = 0.918).

Table 7. Hypothesis testing for structural equation model

	Original Sample	Sample Mean	Standar Deviasi	T Statistics	P Values
SNORM \rightarrow SPB	0,423	0,429	0,074	5,699	0,000
SOCNET \rightarrow SPB	0,407	0,407	0,080	5,097	0,000
STRUST \rightarrow SPB	0,008	0,014	0,077	0,103	0,918

Hypothesis 1 predicted that social norms positively influence sustainable production behavior among coffee farmers. The PLS-SEM results strongly support this hypothesis ($\beta = 0.423$, $t = 5.669$, $p < 0.001$). Among the three social capital dimensions examined, SNORM emerges as the single most influential predictor of SPB, explaining the largest unique portion of variance in farmers' sustainable behavior. This indicates that perceived community expectations regarding environmentally responsible farming substantially shape adoption decisions in Lampung's coffee sector. The path coefficient of 0.423 signifies a moderate-to-strong effect: for everyone standard deviation increases in perceived social norms favoring sustainability, SPB increases by 0.423 standard deviations, holding other variables constant. This finding provides robust empirical support for the Theory of Planned Behavior (Ajzen, n.d.), which positions subjective norms as a core determinant of behavioral intention. In the

collectivist cultural context of rural Lampung, where community cohesion and social harmony are deeply valued, farmers appear highly responsive to group expectations. When sustainable coffee practices such as shade-grown cultivation, organic pest management, and chemical input reduction are perceived as socially endorsed within farming communities or cooperatives, individuals are motivated to maintain social standing and avoid disapproval. This mechanism aligns with the theoretical propositions (Cialdini et al., 1990) who distinguished between descriptive norms (perceptions of what others commonly do) and injunctive norms (perceptions of what others approve or disapprove), both of which likely contribute to the strong SNORM effect observed in this study. Earlier research in Southeast Asian agriculture had demonstrated that normative pressures often outweigh economic incentives in driving pro-environmental behavior (Darnhofer et al., 2010), and the present results confirm that this pattern holds specifically within Lampung's coffee farming context.

Hypothesis 2 predicted that social trust positively influences sustainable production behavior among coffee farmers. Contrary to expectations, the PLS-SEM results do not support this hypothesis ($\beta = 0.008$, $t = 0.103$, $p = 0.918$). The near-zero path coefficient and extremely high p-value indicate not merely statistical non-significance but a virtual absence of any linear relationship between social trust and SPB in this sample. This finding represents a notable departure from the theoretical framework's prediction and constitutes one of the most analytically important results of this study, as it challenges the widely held assumption that all dimensions of social capital uniformly promote sustainable behavior. This null finding contrasts sharply with several studies reviewed in the literature that reported significant trust-sustainability relationships. Most notably, (Snider et al., 2016; Snider, Afonso Gallegos, et al., 2017) demonstrated that Costa Rican farmers with higher trust in cooperative leadership showed significantly greater adoption of certified sustainable practices, including water conservation and biodiversity protection. However, a critical contextual distinction exists: the Costa Rican cooperative system is characterized by long-standing institutional maturity, transparent governance, and established accountability mechanisms that make institutional trust a meaningful predictor of cooperative engagement and, by extension, sustainability adoption. In Lampung, where cooperative institutions may be at different stages of development and where trust dynamics may operate differently, the direct applicability of the Costa Rican model requires qualification.

The results also diverge from (Adane & Bewket, 2022) and (Teshome et al., 2016) who found that Ethiopian smallholders with stronger trust in value chain actors demonstrated enhanced willingness to implement climate adaptation measures despite short-term costs. The Ethiopian context is characterized by significant reliance on formal extension services and government-led adaptation programs, where institutional trust in these entities directly influences farmers' receptivity to their recommendations. In Lampung's more market-oriented and informally organized coffee sector, the pathways through which trust might influence behavior may be structurally different. Within the Indonesian context specifically, (Siregar et al., 2024) and (Afrianto et al., 2024) reported that coffee farmers exhibiting higher institutional trust were more likely to comply with organic production standards and invest in long-term soil health improvements. However, these studies focused on specific forms of institutional trust directed at certification bodies and cooperative organizations, whereas the present study measured generalized social trust, a distinction that may partly explain the divergent findings.

Hypothesis 3 predicted that social networks positively influence sustainable production behavior among coffee farmers. The PLS-SEM results confirm this hypothesis ($\beta = 0.407$, $t = 5.097$, $p < 0.001$). SOCNET emerges as the second most influential predictor of SPB, with a path coefficient only marginally lower than that of SNORM (0.407 vs. 0.423). This indicates that farmers' embeddedness in relational networks encompassing formal connections to cooperatives, extension services, and certification bodies, as well as informal ties to peer farmers, family members, and community groups substantially facilitates the adoption of sustainable production practices. The near-parity of the SNORM and SOCNET effect sizes ($\Delta\beta = 0.016$) suggests that normative influence and informational access are equally potent mechanisms driving sustainability adoption in Lampung's coffee sector. The significance of social networks as a driver of SPB is grounded in the broader theoretical literature on social capital and innovation diffusion. Social networks function as channels for experiential learning, technology diffusion, and access to resources (Hernández-Medina et al., 2025), and (Li et al., 2023) conceptualized social networks as the structural foundation of social capital within agricultural communities, representing the patterns of connections and interactions among actors that facilitate resource exchange, knowledge diffusion, and collective action. In Lampung's coffee landscape where formal extension

services are often limited and geographically dispersed farmers rely heavily on peer-to-peer exchanges within cooperatives, farmer groups, and kinship networks to acquire knowledge about good agricultural practices (GAP) and agroforestry techniques. The present findings validate this theoretical proposition with robust empirical evidence, demonstrating that the structural dimension of social capital is a significant independent predictor of sustainable behavior even when normative and cognitive dimensions are simultaneously modeled.

The cross-regional comparison conducted throughout this discussion reveals notable consistency in the direction of norm and network effects across Latin American, East African, and Southeast Asian coffee-producing contexts, while trust's role varies considerably. In Costa Rica, trust was significant (Snider et al., 2016; Snider, Gutiérrez, et al., 2017) within a mature cooperative system; in Ethiopia, trust operated through formal extension channels (Adane & Bewket, 2022); in Lampung, trust was non-significant in a context where norms and networks dominate. This pattern suggests that trust's behavioral relevance may be contingent on institutional maturity and the degree to which sustainability adoption depends on intermediary institutions versus direct community processes. Where institutional intermediaries are central to sustainability programs (as in Costa Rica's cooperative-led certification systems), institutional trust becomes a significant predictor. Where sustainability adoption is driven primarily by community-level social dynamics (as in Lampung), norms and networks assume primacy.

The strength of each social capital dimension's relationship with behavior may vary across settings while maintaining directional consistency. The present findings partially confirm this: norms and networks show consistent positive effects across global studies, while trust's directionality varies from positive to null depending on context. This contextual contingency in trust's effects as opposed to the robust cross-contextual consistency of normative and network effects constitutes a substantive finding that warrants further systematic investigation through multi-site comparative research (Chang et al., 2025; Li et al., 2023).

Theoretical Contributions

This study makes several distinct contributions to the literature on social capital and sustainable agriculture. First, it provides empirical evidence for dimension-specific effects of social capital on sustainable production behavior, demonstrating that the three classical dimensions structural (networks), cognitive (trust), and normative (norms) do not function as interchangeable predictors but rather as functionally distinct mechanisms with differential behavioral implications. This contradicts the widespread inclination in agricultural sustainability literature to approach social capital as a single construct and underscores the request for disaggregated analysis (Li et al., 2023; Woolcock, 2001).

Second, the study extends the application of social norm theory to Indonesian coffee farming, demonstrating that the normative influence mechanisms documented in Latin American (Folch & Planas, 2019; Méndez et al., 2010; Suárez et al., 2021) and East African (Adane & Bewket, 2022; Teshome et al., 2016) coffee contexts are equally operative in Southeast Asian settings. This cross-regional validation strengthens the generalizability of norm-based theories of sustainable agricultural behavior and provides empirical support for the universality of social identity mechanisms in agricultural decision-making (Akenroye et al., 2021c; Nabillah & Fawzi, 2025).

Third, the null finding for social trust, while departing from the hypothesized relationship, represents a meaningful theoretical contribution. It suggests that trust's relationship with sustainable behavior is conditional rather than universal, potentially operating as a threshold enabler, as a mediator channeled through other social capital dimensions, or as a dimension-specific construct whose behavioral implications depend on the trust target. This challenges theoretical frameworks that position trust as a direct and universal predictor of pro-environmental behavior (Bilfield et al., 2020) and opens productive avenues for future theoretical refinement. The finding aligns with emerging perspectives suggesting that trust may function differently in collectivist versus individualist cultural contexts (Yazdanpanah et al., 2025), with collectivist settings potentially substituting community-based normative enforcement for individual-level trust as the primary behavioral governance mechanism.

Fourth, the near-equality of SNORM and SOCNET effect sizes advances the empirical understanding of how bonding and bridging social capital interact in agricultural sustainability contexts. The balanced contribution of both dimensions in Lampung suggests that community cohesion and external connectivity can co-exist productively, validating Putnam's (2000) theoretical framework while

providing a concrete empirical illustration of the bonding–bridging complementarity that (Woolcock, 2001) theorized as optimal for collective action and development outcomes.

Practical Implications for Sustainability Interventions

The systematic findings across the three research questions generate actionable recommendations for sustainability programs in Lampung’s coffee sector and similar smallholder coffee-producing contexts. The strong effect of social norms (RQ1) suggests that interventions should prioritize norm-formation strategies, including community-based social marketing campaigns that frame sustainable practices as the socially expected behavior, recognition and reward programs for sustainable farmers that elevate their status within the community, cooperative-led sustainability pledges and collective commitments that formalize normative expectations, and demonstration plots and showcase events that make successful sustainable practices visible to the broader farming community. These recommendations align with the intervention approaches documented by (Folch & Planas, 2019; Kairiza et al., 2023; Méndez et al., 2010).

The significant network effect (RQ3) underscores the importance of strengthening and diversifying farmers’ social connections through expanded farmer field school programs, cross-community and cross-regional farmer exchange visits, stronger cooperative governance and membership outreach, digital communication platforms that supplement face-to-face interactions, and mentorship programs linking experienced sustainable farmers with newcomers. Network-strengthening interventions produce compounding benefits because enhanced connectedness improves both information flow and normative influence simultaneously (De Felice et al., 2025; Nuraisyah et al., 2025).

While trust did not emerge as a direct predictor of SPB (RQ2), practitioners should not neglect trust-building altogether. Given the theoretical possibility that trust functions as a prerequisite for norm internalization and network engagement (Chang et al., 2025; Morrow-howell et al., 2003), maintaining and strengthening institutional trust particularly in cooperatives, certification bodies, and extension services remains important as enabling infrastructure. Transparency in cooperative governance, consistent delivery of extension services, and reliable market linkages all contribute to the trust foundation upon which effective norms and networks are built (Bilfield et al., 2020; Edelman et al., 2022). The key policy insight is that trust investment should be framed as supportive of norm and network mechanisms rather than as an independent sustainability lever.

Limitations and Directions for Future Research

Several limitations should be acknowledged and positioned as opportunities for future inquiry. First, the cross-sectional design limits causal inference. While PLS-SEM identifies significant associations, it cannot definitively establish causal direction. Future research should employ longitudinal designs or quasi-experimental approaches such as difference-in-differences analysis around the introduction of cooperative sustainability programs to strengthen causal claims (Bro et al., 2019; Günther et al., 2025).

Second, the measurement of social trust warrants refinement. Future studies should employ multi-dimensional trust instruments that distinguish between generalized interpersonal trust, institutional trust in cooperatives and certification bodies, trust in government agencies and extension services, and systemic trust in market mechanisms. This disaggregated approach, would allow researchers to identify which specific trust targets influence SPB. Additionally, investigating trust as a moderator or mediator rather than solely as a direct predictor of the norms SPB and networks SPB relationships could reveal more nuanced trust dynamics consistent with the threshold explanation proposed above (Bilfield et al., 2020; Edelman et al., 2022; Gao et al., 2022; Yazdanpanah et al., 2025). Third, the geographic focus on Lampung provides contextual depth but limits generalizability. Future research should replicate this model in other Indonesian coffee-producing regions (e.g., North Sumatra, Sulawesi, Bali, Flores) and other commodity systems to test the stability of the observed dimensional pattern. Comparative multi-site studies would enable explicit moderation testing examining whether cooperative maturity, market access, cultural collectivism, and extension service quality moderate the relationships between social capital dimensions and SPB (Chang et al., 2025; Li et al., 2023).

Fourth, interaction effects among social capital dimensions merit investigation. While this study adopted a direct-effects approach for parsimony and practical interpretability, future research could

examine whether norms mediate the network SPB relationship (networks influence behavior by shaping norms) or whether networks moderate the norm SPB relationship (normative effects are stronger among highly connected farmers). Such interaction models would advance the theoretical framework toward greater explanatory complexity while maintaining empirical testability.

Finally, qualitative and mixed-methods approaches could complement these quantitative findings by exploring the lived experiences of farmers navigating social expectations, network pressures, and trust dynamics in their sustainability decisions. In-depth interviews and ethnographic observation could reveal the micro-processes through which norms are formed, communicated, and enforced within Lampung's coffee communities (Méndez et al., 2010; Snider, Afonso Gallegos, et al., 2017), providing richer contextual understanding than survey-based approaches alone and generating hypotheses for subsequent quantitative testing.

CONCLUSION

This study investigates the influence of three dimensions of social capital social norms, social networks, and social trust on farmers' adoption of sustainable production behavior in Lampung's coffee sector using PLS-SEM analysis. The results reveal that social norms and social networks significantly drive sustainable farming practices, with social norms emerging as the strongest predictor, followed closely by social networks, highlighting the importance of community expectations, collective standards, and knowledge-sharing interactions in shaping environmentally responsible behavior within a collectivist rural context. In contrast, social trust does not show a significant direct effect, suggesting its role may be more indirect or contextual rather than immediately behavioral. The model demonstrates strong explanatory and predictive power, confirming the multidimensional nature of social capital where each component functions differently depending on context. Practically, the findings suggest that policymakers and extension programs should prioritize strengthening normative influences through community leaders and enhancing farmer networks via peer learning and digital platforms, while integrating trust-building initiatives as part of long-term strategies. However, this study is limited by its cross-sectional design and focus on direct effects, indicating the need for future longitudinal research and exploration of mediating and moderating variables. Overall, the study emphasizes that advancing sustainable coffee production in Lampung requires not only technical and financial support but also the deliberate strengthening of social structures within farming communities.

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AUTHOR CONTRIBUTIONS

Suprihatin Ali (writing original draft-formal analysis, conceptualization, review data analysis and editing, Christine Wulandari: conceptualization and review data analysis (supporting), Pitojo Budiono conceptualization and review data analysis(supporting), Teguh Endaryanto: conceptualization and review data analysis(supporting), Tugiyono: Conceptualization and review data analysis (supporting). All authors reviewed and approved the final version

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)

Authors use generative AI tools (QWEN.ai) for translating, enhancing the grammar, language, and readability of manuscripts

REFERENCES

- Adane, A., & Bewket, W. (2022). Assessment of stakeholders' roles and linkages in quality coffee production in Yirgacheffe District, southern Ethiopia: Implications for local adaptation to climate change. *Norsk Geografisk Tidsskrift*, 76(3), 164–176. <https://doi.org/10.1080/00291951.2022.2079559>
- Afrianto, W. F., Tanjungsari, R. J., Wati, S. I., Hidayatullah, T., Zulkarnaini, Sari, H. P.,

- Izzudin, M., & Ilham, M. (2024). Sustainability index analysis of traditional organic coffee agroforestry in Pati Regency, Central Java, Indonesia. *Ethnobotany Research and Applications*, 27. <https://doi.org/10.32859/era.27.38.1-22>
- Ajzen, I. (n.d.). *The Theory of Planned Behavior*.
- Akenroye, T. O., Dora, M., Kumar, M., Elbaz, J., Kah, S., & Jebli, F. (2021a). A taxonomy of barriers to the adoption of sustainable practices in the coffee farming process. *Journal of Cleaner Production*, 312(10). <https://doi.org/10.1016/j.jclepro.2021.127818>
- Akenroye, T. O., Dora, M., Kumar, M., Elbaz, J., Kah, S., & Jebli, F. (2021b). A taxonomy of barriers to the adoption of sustainable practices in the coffee farming process. *Journal of Cleaner Production*, 312(10), 127818. <https://doi.org/10.1016/j.jclepro.2021.127818>
- Akenroye, T. O., Dora, M., Kumar, M., Elbaz, J., Kah, S., & Jebli, F. (2021c). A taxonomy of barriers to the adoption of sustainable practices in the coffee farming process. *Journal of Cleaner Production*, 312(October 2020), 127818. <https://doi.org/10.1016/j.jclepro.2021.127818>
- Arifin, B. (2022). Partnership for sustainable coffee certification: Linking up smallholder farmers to global coffee market. *Sustainability Science and Resources*, 2(1), 24–44. <https://doi.org/10.55168/ssr2809-6029.2022.2003>
- Berihun, T., & Gutema, P. (2025). The economic impact of sustainability standards on smallholder coffee producers: Evidence from Ethiopia. *Sustainable Production and Consumption*, 55(October 2024), 268–284. <https://doi.org/10.1016/j.spc.2025.02.022>
- Bilfield, A., Seal, D., & Rose, D. (2020). Brewing a more balanced cup: Supply chain perspectives on gender transformative change within the coffee value chain. *International Journal on Food System Dynamics*, 11(1), 26–38. <https://doi.org/10.18461/ijfsd.v11i1.37>
- Blanco-Pacheco, T. E., De-La-Rosa-Cadavid, M. L., & Quintero-Castañeda, C. Y. (2025). Corporate sustainability in the coffee industry: Organic certification for small producers in the sierra nevada de santa marta, Colombia. *Sustainability (Switzerland)*, 17(24), 1–23. <https://doi.org/10.3390/su172410975>
- Bray, J. G., Arifin, B., Ismono, H., & Neilson, J. (2023). *Sustainability Standards and Social Network Development : Indonesian Coffee Farmers ' Unpredictable Impact Pathways to Achieving a Living Income*. 154(3), 112–122. <https://doi.org/https://doi.org/10.12854/erde-2023-641>
- Bro, A. S., Clay, D. C., Ortega, D. L., & Lopez, M. C. (2019). Determinants of adoption of sustainable production practices among smallholder coffee producers in Nicaragua. *Environment, Development and Sustainability*, 21(2), 895–915. <https://doi.org/10.1007/s10668-017-0066-y>
- Chang, Z., Ahmed, N., Li, R., & Huai, J. (2025). Social capital, crop differences, and farmers' climate change adaptation behaviors: Evidence from yellow river, China. *Agriculture (Switzerland)*, 15(13). <https://doi.org/10.3390/agriculture15131399>
- Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, 58(6), 1015–1026. <https://doi.org/10.1037/0022-3514.58.6.1015>
- Darnhofer, I., Bellon, S., Dedieu, B., Milestad, R., Darnhofer, I., Bellon, S., Dedieu, B., & Milestad, R. (2010). *Adaptiveness to enhance the sustainability of farming systems . A review To cite this version : HAL Id : hal-00886511 Review article Adaptiveness to enhance the sustainability of farming systems .* https://doi.org/10.1007/978-94-007-0394-0_4
- De Felice, F., Rehman, M., Petrillo, A., & Baffo, I. (2025). Decoding the coffee supply chain: A systematic review of stakeholders, sustainability opportunities, and challenges. *Sustainable Futures*, 10(6), 101105. <https://doi.org/10.1016/j.sftr.2025.101105>

- Edelmann, H., Quiñones-Ruiz, X. F., & Penker, M. (2022). How close do you like your coffee? - Examining proximity and its effects in relationship coffee models. *Journal of Rural Studies*, 91(January), 24–33. <https://doi.org/10.1016/j.jrurstud.2022.02.007>
- Elkington, J. (1998). Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Environmental Quality Management*, 8(1), 37–51. <https://doi.org/10.1002/tqem.3310080106>
- Faila Sophia Hartatri, D., Aklimawati, L., & Neilson, J. (2019). Analysis of specialty coffee business performances: focus on management of farmer organizations in Indonesia. *Pelita Perkebunan (a Coffee and Cocoa Research Journal)*, 35(2), 140–155. <https://doi.org/10.22302/icri.jur.pelitaperkebunan.v35i2.382>
- Folch, A., & Planas, J. (2019). Cooperation, fair trade, and the development of organic coffee growing in chiapas (1980-2015). *Sustainability (Switzerland)*, 11(2). <https://doi.org/10.3390/su11020357>
- Gao, Y., Peng, S., Hang, Y., Xie, G., Ji, N., & Zhang, M. (2022). Mycorrhizal fungus *Coprinellus disseminatus* influences seed germination of the terrestrial orchid *Cremastra appendiculata* (D. Don) Makino. *Scientia Horticulturae*, 293. <https://doi.org/10.1016/j.scienta.2021.110724>
- Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural equation modeling and regression: guidelines for research practice. *Communications of the Association for Information Systems*, 4(October). <https://doi.org/10.17705/1cais.00407>
- Günther, M. K., Bosch, C., Ewell, H., Nawrotzki, R., & Kato, E. (2025). Step by step to higher yields? Adoption and impacts of a sequenced training approach for climate-smart coffee production in Uganda. *International Journal of Agricultural Sustainability*, 23(1). <https://doi.org/10.1080/14735903.2025.2545042>
- Hair, J. F., Babin, B. J., Ringle, C. M., Sarstedt, M., & Becker, J.-M. (2025). Covariance-based structural equation modeling (CB-SEM): a SmartPLS 4 software tutorial. *Journal of Marketing Analytics*, 13(3), 709–724. <https://doi.org/10.1057/s41270-025-00414-6>
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019a). The results of PLS-SEM article information. *European Business Review*, 31(1), 2–24. <https://doi.org/10.1108/eb-11-2018-0203>
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019b). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24. <https://doi.org/10.1108/EBR-11-2018-0203>
- Hair Jr et al. (2021). Partial least squares structural equation modeling (PLS-SEM) using R: A workbook (p. 197). Springer Nature. In *Structural Equation Modeling: A Multidisciplinary Journal*, 30(4), <https://doi.org/10.3390/books978-3-0365-2621-8>
- Harahap, R. H., Rauf, A., Rahmawaty, Sadalia, I., Aulia, F., & Nasution, A. A. (2025). Adoption of good agricultural practices (GAP) among arabica coffee farmers in Simalungun, Indonesia. *Research on World Agricultural Economy*, 6(4), 191–204. <https://doi.org/10.36956/rwae.v6i4.1897>
- Haryono, A., Juniarti, I., Matajat, K., Suroso, A. I., & Soesilo, M. (2024). Partnership development of smallholder coffee cultivation: A model for social capital in the global value chain. *Economies*, 12(12), 349. <https://doi.org/10.3390/economies12120349>
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2016). Testing measurement invariance of composites using partial least squares. *International Marketing Review*, 33(3), 405–431. <https://doi.org/10.1108/IMR-09-2014-0304>
- Hernández-Medina, P., Pinilla-Rodríguez, D., Fuentes-Gavilanez, L., & Paublini-Hernández, M. A. (2025). Networks, relational and structural social capital: In the association of artisans in the ecuadorian andes. *Geojournal of Tourism and Geosites*, 60(2), 1107–1118.

- <https://doi.org/10.30892/gtg.602spl08-1484>
- Irawan, A., Rabemanolontsoa, H., & McLellan, B. C. (2024). Comprehensive environmental impact analysis of dry processing methods for specialty coffee beans in bondowoso, indonesia using life cycle assessment. *Biomass (Switzerland)*, 4(3), 843–864. <https://doi.org/10.3390/biomass4030047>
- Istiqomah, R. N., Setyaningsih, W., Mustafa, A. K., & Ihsaniyati, H. (2024). Benefits of knowledge sharing by farmers to encourage implementation of robusta coffee production standard. *IOP Conference Series: Earth and Environmental Science*, 1362(1). <https://doi.org/10.1088/1755-1315/1362/1/012012>
- Jara-Rojas, R., Canales, R., Gil, J. M., Engler, A., Bravo-Ureta, B., & Bopp, C. (2020). Technology adoption and extension strategies in mediterranean agriculture: The case of family farms in Chile. *Agronomy*, 10(5). <https://doi.org/10.3390/agronomy10050692>
- Kairiza, T., Kembo, G., Magadzire, V., & Chigusiwa, L. (2023). Gender gap in the impact of social capital on household food security in Zimbabwe: does spatial proximity matter? *Review of Economics of the Household*, 21(1), 245–267. <https://doi.org/10.1007/s11150-021-09592-5>
- Kitano, S. (2025). The effect of social capital on organic farming and its heterogeneity. *Organic Agriculture*, 15(2), 345–360. <https://doi.org/10.1007/s13165-025-00501-z>
- Kudama, G., Wana, H., & Dangia, M. (2021). The adoption of bundled sustainable farm and environmental practices by coffee farmers in southwest Ethiopia. *Scientific World Journal*, 2021. <https://doi.org/10.1155/2021/9954230>
- Kurniawan, B. P. Y., Wardati, I., Ardiani, F., & Noviana, G. (2021). A theoretical model for increasing the coffee farmers groups' institutional capacity. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3960594>
- Li, L., Jin, J., He, R., Kuang, F., Zhang, C., & Qiu, X. (2023). Effects of social capital on farmers' choices of climate change adaptation behavior in Dazu District, China. *Climate and Development*, 15(2), 110–121. <https://doi.org/10.1080/17565529.2022.2061403>
- Mathanda, H., Pangapanga-Phiri, I., Tufa, A., Mangisoni, J., Alene, A., Ngoma, H., Phiri, H. H., & Chikoye, D. (2025). Does social capital influence the intensity of conservation agriculture adoption among smallholder farmers in Malawi? *Environmental and Sustainability Indicators*, 26(October 2024), 100630. <https://doi.org/10.1016/j.indic.2025.100630>
- Méndez, V. E., Bacon, C. M., Olson, M., Petchers, S., Herrador, D., Carranza, C., Trujillo, L., Guadarrama-Zugasti, C., Córdón, A., & Mendoza, A. (2010). Effects of fair trade and organic certifications on small-scale coffee farmer households in Central America and Mexico. *Renewable Agriculture and Food Systems*, 25(3), 236–251. <https://doi.org/10.1017/S1742170510000268>
- Morel, A. C., Hiron, M., Demissie, S., Gonfa, T., Mehrabi, Z., Long, P. R., Rifai, S., Woldemariam Gole, T., Mason, J., McDermott, C. L., Boyd, E., Robinson, E. J. Z., Malhi, Y., & Norris, K. (2019). The structures underpinning vulnerability: Examining landscape-society interactions in a smallholder coffee agroforestry system. *Environmental Research Letters*, 14(7). <https://doi.org/10.1088/1748-9326/ab2280>
- Morrow-howell, N., Hinterlong, J., Rozario, P. A., & Tang, F. (2003). Morrowhowell2003.Pdf. *The Gerontological Society of America*, 58(3), 137–145. <https://doi.org/10.1093/geronb/58.3.s137>
- Morrow, E., & Scorgie-Porter, L. (2017). Bowling Alone: The Collapse and Revival of American Community. *Bowling Alone: The Collapse and Revival of American Community*, 1–84. <https://doi.org/10.4324/9781912282319>
- Mumtaz, A. M., Hiram, T., Jun-Hwa, C., Ramayah, T., Francis, C., & Tat, H. C. (2020).

- Sample size for survey research: Review and recommendations. *Journal of Applied Structural Equation Modeling*, 4(2), 2590–4221. [https://doi.org/10.47263/jasem.4\(2\)01](https://doi.org/10.47263/jasem.4(2)01)
- Nabillah, R., & Fawzi, N. I. (2025). Defining social sustainability through social capital in the small-scale coconut plantation ecosystem in Indragiri Hilir, Indonesia: A preliminary study. *BIO Web of Conferences*, 158. <https://doi.org/10.1051/bioconf/202515802001>
- Nguyen, N., & Drakou, E. G. (2021). Farmers intention to adopt sustainable agriculture hinges on climate awareness: The case of vietnamese coffee. *Journal of Cleaner Production*, 303. <https://doi.org/10.1016/j.jclepro.2021.126828>
- Nisak, F. F., Prayitno, G., Ari, I. R. D., Hidayat, A. R. T., Waloejo, B. S., Usman, F., Wijayati, W. P., & Onishi, M. (2025). Quantifying the synergistic effects of social and human capital in farmers' decisions to adopt organic rice farming: A case study of Lombok Kulon village, Indonesia. *Environmental Challenges*, 20(December 2024), 101204. <https://doi.org/10.1016/j.envc.2025.101204>
- Nuraisyah, A., Wulandari, E., Indrawan, D., & Othman, Z. (2025). The roles of stakeholders in supply chain sustainability challenges: The case of coffee chain in West Java Province, Indonesia. *Discover Sustainability*, 6(1). <https://doi.org/10.1007/s43621-025-01004-3>
- Prayitno, G., Fikriyah, Nugraha, A. T., Siankwilimba, E., Wicaksono, A. D., Dinanti, D., Subagiyo, A., Hoque, M. E., & Hiddlestone-Mumford, J. (2025). The role of social and human capital on climate change adaptation in agricultural activities in Indonesia. *Environmental Challenges*, 21(5), 101353. <https://doi.org/10.1016/j.envc.2025.101353>
- Ren, Z., Fu, Z., & Zhong, K. (2022). The influence of social capital on farmers' green control technology adoption behavior. *Frontiers in Psychology*, 13(October), 1–14. <https://doi.org/10.3389/fpsyg.2022.1001442>
- Rizka Esty Wulandari, Bustanul Arifin, Z. A., & Jurusan. (2019). *Analisis Perilaku Petani Kopi Sertifikasi Dalam Mengelola Risiko Lingkungan*. 7(3), 368–376.
- Rocha, G. A., Viviani, M. J., Ferreira, M. A., Zaro, E. S., Cunha Neto, A. R. da, & Tiezzi, R. de O. (2025). Sustainability certifications in Brazilian coffee: A multidimensional comparative analysis. *Revista Brasileira de Ciencias Ambientais*, 60(1), 1–13. <https://doi.org/10.5327/Z2176-94782338>
- Siregar, M. A., Effendi, I., Tambunan, S., & Pratama, I. (2024). A sustainable economic model for organic coffee production in Indonesia: Integrating local wisdom and key agricultural factors. *AgBioForum*, 26(2), 55–65.
- Snider, A., Afonso Gallegos, A., Gutiérrez, I., & Sibelet, N. (2017). Social capital and sustainable coffee certifications in Costa Rica. *Human Ecology*, 45(2), 235–249. <https://doi.org/10.1007/s10745-017-9896-3>
- Snider, A., Gutiérrez, I., Sibelet, N., & Faure, G. (2017). Small farmer cooperatives and voluntary coffee certifications: Rewarding progressive farmers of engendering widespread change in Costa Rica? *Food Policy*, 69, 231–242. <https://doi.org/10.1016/j.foodpol.2017.04.009>
- Snider, A., Kraus, E., Sibelet, N., Bosselmann, A. S., & Faure, G. (2016). Influence of voluntary coffee certifications on cooperatives' advisory services and agricultural practices of smallholder farmers in Costa Rica. *Journal of Agricultural Education and Extension*, 22(5), 435–453. <https://doi.org/10.1080/1389224X.2016.1227418>
- Suárez, A. E., Gutiérrez-Montes, I., Ortiz-Morea, F. A., Ordoñez, C., Suárez, J. C., & Casanoves, F. (2021). Dimensions of social and political capital in interventions to improve household wellbeing: Implications for coffee-growing areas in southern Colombia. *PLoS ONE*, 16(1 January), 1–27. <https://doi.org/10.1371/journal.pone.0245971>
- Teshome, A., de Graaff, J., & Kassie, M. (2016). Household-level determinants of soil and water conservation adoption phases: Evidence from north-western Ethiopian highlands.

- Environmental Management*, 57(3), 620–636. <https://doi.org/10.1007/s00267-015-0635-5>
- Thom, B., Sigrist, M., Späth, L., Banyanga, D., Stettler, M., Schneider, G., Pfister, S., Kintche, K., & Jacobi, J. (2025). Mismatches in the coffee value chain: From basic needs to hedonistic lifestyles—experiences from Brazil, the democratic republic of Congo, and Switzerland. *Frontiers in Sustainable Food Systems*, 9(November). <https://doi.org/10.3389/fsufs.2025.1623366>
- Verburg, R., Rahn, E., Verweij, P., van Kuijk, M., & Ghazoul, J. (2019). An innovation perspective to climate change adaptation in coffee systems. *Environmental Science and Policy*, 97(March), 16–24. <https://doi.org/10.1016/j.envsci.2019.03.017>
- Woolcock, M. (2001). Microenterprise and social capital: A framework for theory, research, and policy. *Journal of Socio-Economics*, 30(2), 193–198. [https://doi.org/10.1016/S1053-5357\(00\)00106-2](https://doi.org/10.1016/S1053-5357(00)00106-2)
- Wulandari, C., & Inoue, M. (2018). The importance of social learning for the development of community based forest management in Indonesia: The case of community forestry in Lampung province. *Small-Scale Forestry*, 17(3), 361–376. <https://doi.org/10.1007/s11842-018-9392-7>
- Wulandari, C., Iswandaru, D., Mora, A. M., Sirait, E. R. N. S., Dessy, A., & Novriyanti, N. (2025). Assessing the role of social networks in sustainable post-fire peatland management. *Journal of Human, Earth, and Future*, 6(1), 84–94. <https://doi.org/10.28991/HEF-2025-06-01-06>
- Yazdanpanah, M., Zobeidi, T., Homayoon, S. B., Komendantova, N., Lamm, A., Lamm, K., & Woosnam, K. M. (2025). Harvesting resilience: The role of social capital in driving adaptive behaviour among Iranian farmers. *Climate and Development*, 5529, 1–15. <https://doi.org/10.1080/17565529.2025.2592072>
- Zhang, Y., Hu, N., Yao, L., Zhu, Y., & Ma, Y. (2023). The role of social network embeddedness and collective efficacy in encouraging farmers' participation in water environmental management. *Journal of Environmental Management*, 340(April), 117959. <https://doi.org/10.1016/j.jenvman.2023.117959>