

THE ROLE OF FARMER GROUP MEMBERSHIP IN LINKING SOCIAL CAPITAL TO SUSTAINABLE PRODUCTION: EVIDENCE FROM COFFEE GROWERS IN LAMPUNG, INDONESIA

O PAPEL DA PARTICIPAÇÃO EM GRUPOS DE AGRICULTORES NA RELAÇÃO ENTRE O CAPITAL SOCIAL E A PRODUÇÃO SUSTENTÁVEL: EVIDÊNCIAS ENTRE OS PRODUTORES DE CAFÉ EM LAMPUNG, NA INDONÉSIA

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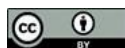
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Abstract

This study examines how farmer group membership (POKTAN) moderates the relationship between multidimensional social capital and the adoption of sustainable practices among coffee growers in Lampung, Indonesia. Using a cross-sectional survey of 210 smallholder farmers (105 members and 105 non-members) in Tanjung Raja and SEM analysis with SmartPLS, social networks, trust, and norms were evaluated. Results show that membership transforms rather than uniformly strengthens social capital: social networks are the strongest driver for members (path=0.576, $p < 0.001$) versus non-members (0.278); social norms act universally, with slightly stronger effects for non-members (0.402 vs. 0.358); trust significantly influences only non-members (0.263, $p < 0.01$), being non-significant and negative for members (-0.145), suggesting a shift

Resumo

Este estudo examina como a filiação a grupos de agricultores (POKTAN) modera a relação entre o capital social multidimensional e a adoção de práticas sustentáveis entre os cafeicultores de Lampung, na Indonésia. Por meio de uma pesquisa transversal com 210 pequenos agricultores (105 membros e 105 não membros) em Tanjung Raja e da análise SEM com o SmartPLS, foram avaliadas as redes sociais, a confiança e as normas. Os resultados mostram que a filiação transforma, em vez de fortalecer uniformemente, o capital social: as redes sociais são o fator mais forte para os membros (path=0,576, $p < 0,001$) em comparação com os não membros (0,278); as normas sociais atuam universalmente, com efeitos ligeiramente mais fortes para os não membros (0,402 vs. 0,358); a confiança influencia significativamente apenas os não membros (0,263, $p < 0,01$), sendo



toward institutional dependency. Discriminant validity issues ($HTMT > 1.0$) indicate dimensional overlap among members. In conclusion, POKTAN membership converts informal networks into structured resources, highlighting the need for improved group governance and inclusive extension strategies to maximize social capital's impact on sustainable coffee production.

Keywords: Sustainable Coffee Production. Membership Group. Coffee Farmers.

insignificante e negativa para os membros (-0,145), sugerindo uma mudança em direção à dependência institucional. Questões de validade discriminante ($HTMT > 1,0$) indicam sobreposição dimensional entre os membros. Em conclusão, a filiação ao POKTAN converte redes informais em recursos estruturados, destacando a necessidade de melhoria na governança do grupo e de estratégias de extensão inclusivas para maximizar o impacto do capital social na produção sustentável de café.

Palavras-chave: Produção Sustentável de Café. Grupo de Filiação. Produtores de Café.

1 INTRODUCTION

Farmer group membership functions as a crucial institutional mediator that transforms the relationship between social capital and sustainable farming practices. Social capital encompassing social networks, trust, and shared norms significantly enhances farmers' adoption of sustainable agricultural practices beyond mere technology accessibility or economic incentives (Liu *et al.*, 2024). Contemporary scholarship defines social capital through three interconnected dimensions: bonding ties within homogeneous groups that foster mutual support and resource sharing; bridging ties between different social groups that provide access to new knowledge and innovation; and linking ties to formal institutions that connect farmers to markets, policy resources, and technical services (de Brito *et al.*, 2024; Gören, 2026). These dimensions collectively enhance climate resilience: bonding capital enables communal resource sharing in emergencies, bridging ties propagate adaptive knowledge concerning drought-resistant practices, and linking ties secure institutional support for irrigation infrastructure, thereby establishing social capital as a critical non-material adaptive capacity for resource-constrained smallholders (Carrico *et al.*, 2019). This comprehensive approach holds particular significance for Indonesian agriculture, where robust bridging connections among peatland farmers have facilitated the adoption of sustainable restoration practices following fires. By enabling inter-village knowledge exchange and fostering collaborative monitoring efforts, these networks empower farmers to collectively respond

to environmental challenges and implement long-term ecological recovery strategies (Wulandari *et al.*, 2025).

But turning social capital into long-term action is not easy or always the same; its success depends on cognitive filters, structural positions, and behavioral patterns in the way farmers make decisions. Farmers exhibit significant variability in their trust in sustainability information sources, distinguishing between extension agents, peer farmers, digital platforms, and buyer requirements, which substantially affects the degree of green behavior adoption (Lv & Li, 2023).

This cognitive dimension overlaps with the benefits of structural networks. Social network brokers connect social groups that would otherwise be cut off from each other. They do this by making it easier for knowledge to flow across groups that aren't already connected. This is a better way to spread new ideas than by using well-known opinion leaders. (Zhang *et al.*, 2020). Trust and network density both play a role in farmers' adoption of green control technology. Institutional trust acts as a bridge between network strength and behavioral results (Ren *et al.*, 2022).

Moreover, Mgema *et al.* (Mgema *et al.*, 2025) showed in Tanzania that structural social capital improves livelihood outcomes solely when coupled with moderate-to-high risk-taking behavior, highlighting that networks alone are inadequate without supportive behavioral traits. These processes are clear in different types of goods. For example, Indonesian coffee farmers' participation in Voluntary Sustainability Standards (VSS) programs made it possible for new connections to be made between smallholders who were previously isolated and international buyers and certification organizations (Bray *et al.*, 2023). But it led to unpredictable revenue results because the brokerage capacity of farmer groupings was different. In Ethiopia, bonding social capital alone was inadequate for climate adaptation; only farmers possessing both strong internal cohesion and exterior bridging/linking ties successfully implemented various adaptation techniques in the face of climatic stress. (Belay & Fekadu, 2021).

Being a member of farmers' groups is a way that institutions can change how social capital works throughout sustainability transitions. Groups act as integrators of social capital by strengthening bonding ties (through shared identity and mutual accountability), activating bridging ties (through inter-group exchanges and collective learning platforms), and institutionalizing linking ties (through formal partnerships with

cooperatives, research institutions, and market actors). This way, they meet the many different needs that have been found in different agro-ecological contexts (de Brito *et al.*, 2024; Gören, 2026). They work together to manage the risks that come with adopting new sustainable practices by sharing equipment for soil conservation, pooling money for organic inputs, and sharing the risk of market fluctuations. This makes it easier to overcome the problems that found by Carrico *et al.* (Carrico *et al.*, 2019) and Mgema *et al.* (Mgema *et al.*, 2025).

Groups act as trustworthy middlemen who change how much trust people have in different sources of sustainability information by putting external recommendations from VSS requirements to climate advisories through group verification processes, groups make information more credible and speed up behavioral change among their members (Lv & Li, 2023). This function is particularly critical in commodity value chains, where effective farmer groups in Indonesia turned fragmented individual interactions with buyers into coordinated collective bargains, so transforming weak linking ties into substantial market leverage (Bray *et al.*, 2023). Additionally, groups institutionalize the brokerage function identified by Zhang *et al.* (Zhang *et al.*, 2020), transforming informal network advantages into systematic diffusion frameworks in which designated members disseminate innovations across diverse landscape scales. This is exemplified in Wulandari *et al.*'s (Wulandari *et al.*, 2025) peatland restoration networks, where group-coordinated monitoring committees functioned as formalized brokers to ensure compliance with established practices.

The existence of farmer groups will help farmers minimize transaction costs and information imbalances, which in turn can enable farmers to negotiate more competitive output and input prices. Along with the increasingly evolving transformation of the agribusiness value chain, coupled with the importance of high quality standards and new procurement systems developed by large and formal agribusiness companies in developing countries, farmer group participation can be an effective strategy for small farmers to access these formal institutions (Baga *et al.*, 2023).

Consequently, understanding sustainable agricultural transitions requires moving beyond individual assessments of social capital to examine how group affiliation actively shapes its complex dynamics. Groups not only improve existing social capital, but they also change its basic function by bringing together structural networks, changing

cognitive trust, encouraging behavioral risk-taking, and encouraging joint action within a same institutional framework. This all-encompassing viewpoint, supported by evidence from several contexts related to climate adaptation (Belay & Fekadu, 2021; de Brito *et al.*, 2024), The theoretical framework for developing interventions that use collective organization as a catalyst for comprehensive sustainability transitions among smallholder farmers is based on technology adoption (Ren *et al.*, 2022), landscape restoration (Wulandari *et al.*, 2025), and value chain integration (Bray *et al.*, 2023), establishes a solid theoretical framework for crafting interventions that utilize collective organization as a catalyst for comprehensive sustainability transitions among smallholder farmers. This paradigm shows how Indonesian coffee systems can help groups of farmers move from being passive sources of information to active builders of integrated sustainability, encouraging environmental stewardship, economic viability, and social equality in the face of climate unpredictability.

2 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

This study aims to contribute to the literature on farmers' decision-making for sustainable agricultural development by empirically examining the moderating role of farmers' group membership in the relationship between social capital and the adoption of sustainable farming practices. Specifically, the research investigates whether significant behavioral differences exist between group members and non-members in their implementation of sustainable agriculture particularly in terms of adoption intensity, practice diversity, risk-taking in trialing innovations, and persistence in maintaining environmentally sound practices over time. Grounded in the multidimensional framework of social capital (bonding, bridging, and linking ties) (Gören, 2026), this research posits that group membership reconfigures how farmers access, interpret, and act upon sustainability-related information and resources, thereby generating distinct behavioral trajectories between the two cohorts. This study investigates how social capital operationalized through its core dimensions of social norms, trust, and network ties influences sustainable production behavior among coffee farmers in Indonesia's Lampung Province, a key region within the country's robust coffee sector. Many studies show that

elements of social capital (social norms, social trust, and social networks) are important drivers of sustainable and green production behaviors in agriculture and other sectors.

In this study, social capital, which includes networks, trust, and norms, is a key factor that makes it easier for agricultural transformations to be long-lasting. It does this by lowering transaction costs, spreading knowledge, and encouraging environmentally friendly behaviors. (Akenroye *et al.*, 2021; Nguyen & Drakou, 2021). In smallholder settings with limited formal institutions, these relational resources frequently serve as substitutes for or enhancements to market-based incentives in facilitating the adoption of practices. (Djufry & Wulandari, 2021; Prasmatiwi *et al.*, 2025).

Social networks are ways for people to learn from each other and share technology. Farmers that are part of dense, diversified networks are more likely to meet other farmers who have successfully used sustainable methods, which lowers perceived risks and speeds up the spread of these practices. (Prayitno *et al.*, 2025; Wulandari *et al.*, 2025). Empirical research from Indonesian agricultural systems indicates that farmers with robust network connections show greater adoption rates of climate-smart approaches, as networks provide access to both tacit knowledge and tangible resources. (Prayitno *et al.*, 2025; Saptutyningasih *et al.*, 2020). Network-mediated learning has been essential in coffee systems for sharing complicated agroforestry and soil conservation techniques that need to be adapted to specific areas (Djufry & Wulandari, 2021; Prasmatiwi *et al.*, 2025).

Generalized trust in community members and institutions is a barrier to collective action and makes people more open to sustainability initiatives from outside the community (Haryono *et al.*, 2024; Ortega *et al.*, 2019). Trust lessens the chances of people acting opportunistically in resource-sharing arrangements, including seed exchanges and labor pooling, that are necessary for using tactics like cover cropping or integrated pest management (Nyambune Maindi & Nyarindo, 2024). Research on smallholder systems in Southeast Asia indicates that farmers exhibiting elevated trust levels are more inclined to embrace approaches yielding delayed returns, as trust mitigates uncertainty over long-term advantages. (Prayitno *et al.*, 2025; Saptutyningasih *et al.*, 2020). But trust may not always work: in places with strong formal institutions (like cooperatives), broad trust may be replaced by faith in specific institution (Mutonyi, 2019).

Social norms have a strong effect through descriptive (what other people do) and injunctive (what other people approve) ways. (Akenroye *et al.*, 2021). When sustainable practices become the norm in a society, farmers get social benefits for following them and punishments for not doing so. This leads to cycles of behavioral change that reinforce themselves (Akenroye *et al.*, 2021; Nguyen & Drakou, 2021). Studies in Indonesian agriculture indicate that normative pressure is a key predictor of climate adaptation practices, especially in contexts of clearly shared environmental degradation. (Saptutyningsih *et al.*, 2020). In coffee landscapes, norms on shade-tree retention or pesticide reduction frequently arise organically through community deliberation, subsequently impacting individual practice choices irrespective of economic incentives (Djufray & Wulandari, 2021; Prasmatiwi *et al.*, 2025).

Together, these dimensions produce synergistic effects: Networks communicate normative expectations, trust facilitates norm enforcement, and norms enhance network cohesion. (Prayitno *et al.*, 2025; Saptutyningsih *et al.*, 2020). Prior research confirms beneficial relationships between social capital and sustainability outcomes across global contexts (Nguyen & Drakou, 2021; Ortega *et al.*, 2019; Prasmatiwi *et al.*, 2025), Evidence pertaining to Indonesian coffee smallholders, especially in climate-sensitive areas such as Lampung, is still scarce. This study fills this gap by investigating how each variable affects North Lampung coffee producers' adoption of sustainable practices on its own. The hypotheses in this part of the model are as follows:

H₁: There is a positive link between social networks and the number of smallholder coffee producers in North Lampung who use sustainable farming methods.

H₂: Social trust is positively correlated with the degree of sustainable agricultural practice adoption among smallholder coffee producers in North Lampung.

H₃: Social norms of environmental stewardship are favorably correlated with the implementation of sustainable agricultural practices among smallholder coffee producers in North Lampung.

H₄: The correlation between elements of social capital (social networks, social trust, and social norms) and the adoption of sustainable agricultural practices varies markedly between cooperative members and non-members among smallholder coffee farmers in North Lampung.

The study utilizes a comparative cross-sectional approach, stewardship incorporating 210 coffee producers intentionally selected from Tanjung Raja District, North Lampung Regency. Importantly, the sample consists of two separate cohorts: farmers who are active participants in formal farmer associations (GAPOKTAN) and non-member farmers farming analogous coffee varieties under similar agro-ecological conditions. The study commences with an analysis of the impact of multidimensional social capital, as manifested through social norms, trust, and network relationships, on sustainable production practices among smallholder coffee producers. Based on the three-part concept of bonding, bridging, and linking social capital (Gören, 2026), This study transcends the conceptualization of social capital to examine how its unique features significantly influence farmers' adoption of environmentally sustainable practices, including shade control, soil conservation, organic fertilization, and water-efficient processing techniques.

This paper utilizes a multivariate methodology representing structural equation modelling analysis with interaction terms to test both direct relationships. Data were collected through structured surveys administered to 210 coffee farmers in Tanjung Raja District, North Lampung Regency, Lampung Province, Indonesia a region characterized by smallholder-dominated kopi robusta production systems. The sample was stratified to ensure balanced representation between farmers' group members (n = 105) and non-members (n = 105), matched by farm size, altitude zone, and years of coffee cultivation experience to control for confounding agro-ecological and socioeconomic factors. Social capital dimensions were measured using multi-item Likert scales validated in agricultural contexts: social norms, trust, and network ties. Sustainable production behavior was measured using a composite sustainability index that integrates economic, social, and ecological dimensions. The main objectives of the present study are to investigate: (1) the direct effects of social norms, trust, and network ties on sustainable coffee production behavior; (2) behavioral differences in sustainable practice adoption between farmers' group members and non-members.

3.2 Sampling procedure and sample characteristics

A purposive sampling strategy was implemented to select 210 coffee farmers who represented information-rich cases for comparative analysis between group members and non-members. The characteristics of sample provide in table 1 as follow:

Table 1

Demographic characteristics of farmers

Characteristic	M		NM	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Duration of coffee farming				
1-10 years	29	27.6	33	31.4
11-20 years	32	30.5	27	25.7
21-30 years	22	21	32	30.5
31-40 years	12	11.4	7	6.7
41-50 years	8	7.6	5	4.8
51-60 years	2	1.9	1	1.0
Production per Year				
< 500 Kg	28	26.7	32	30.5
500-1000 Kg	31	29.5	37	35.2
1000-2000 Kg	22	21.0	15	14.3
> 2000 Kg	24	22.9	21	20.0
Income				
< Rp. 10 million/Year	27	25.7	25	23.8
Rp. 10-20 million/Year	30	28.6	34	32.4
Rp. 20-30 million/Year	17	16.2	14	13.3
> Rp. 30 million/Year	31	29.5	32	30.5

Remarks: M = Member of group, NM = Non-member of group

3.3 Measurement of variables

In order to guarantee the content validity of the measurement instrument, it must represent as accurately as possible the multidimensional constructs it is intended to capture (Rusticus (2014) in Michalos & George, 2014). Accordingly, a 39-item instrument was developed across four latent constructs grounded in established theoretical frameworks: Sustainable Production Behavior (SPB; 21 items) operationalized through Elkington's Triple Bottom Line dimensions (economic, social, ecological) (Elkington, 1998), and three social capital dimensions Social Norms (5 items),

Social Trust (7 items), and Social Network (6 items) structured according to Putnam's tripartite model (bonding, bridging, linking) (Gören, 2026; Xie *et al.*, 2023). Items were either directly derived from theoretical definitions of sustainable agricultural behavior (Arifin, 2022b, 2022a) and social capital components (Cialdini *et al.*, 1990) or adapted from validated scales in Indonesian coffee contexts (Arifin, 2021; Bray *et al.*, 2023; Haryono *et al.*, 2024; Wulandari *et al.*, 2025) and global smallholder studies (Belay & Fekadu, 2021; de Brito *et al.*, 2024; Ren *et al.*, 2022; Zhang *et al.*, 2020). All items were contextualized to Lampung's kopi robusta systems through iterative consultation with extension officers and pilot testing with 50 coffee farmers to ensure ecological and cultural relevance. Constructs were measured using 5-point Likert scales (1 = strongly disagree to 5 = strongly agree), with item allocation per sub-dimension exceeding the psychometric minimum of three items per factor (Raubenheimer, 2004) to ensure robust construct identification while maintaining acceptable respondent burden for field administration. SPSS25 and SmartPLS was used for descriptive analysis, including frequency, percentage, and measurement and structural model analysis (Hair *et al.*, 2019).

Table 2

Measurement variables and scales for key constructs

Code	Item	SOCNET		STRUST		SNORM		FSB	
		M	NM	M	NM	M	NM	M	NM
SOCNET1	I actively participate in coffee farmer groups/cooperatives	0.748	0.801						
SOCNET2	I have regular contact with buyers/regular customers	0.422	0.627						
SOCNET3	I am a member of a coffee farmer group	0.793	0.768						
SOCNET4	I have access to agricultural extension workers/coffee experts	0.695	0.416						
SOCNET5	I regularly share information with other coffee business actors	0.679	0.574						
SOCNET6	I regularly share information with other coffee business actors	0.752	0.642						
STRUST1	I trust my fellow coffee farmers			0.728	0.720				
STRUST2	I believe the information shared in farmer groups is trustworthy			0.757	0.784				

STRUST3	I believe farmer groups/cooperatives work for the benefit of their members	0.759	0.803
STRUST4	I believe coffee buyers will honor price agreements	0.737	0.621
STRUST5	I believe the government supports coffee plantation development	0.689	0.542
STRUST6	I believe fellow farmers will not disadvantage me	0.809	0.593
STRUST7	I believe coffee buyers will not disadvantage me	0.721	0.629
SNORM1	I comply with quality standards in coffee production/processing	0.807	0.809
SNORM2	I implement sustainable practices (social forestry/sustainable agriculture) in coffee production	0.813	0.772
SNORM3	I am committed to fair price agreements	0.619	0.749
SNORM4	I follow the rules in farmer groups/associations	0.725	0.764
SNORM5	I participate in social/community activities of the coffee community	0.581	0.736
FSB1	I regularly record all expenses and income of my coffee farming business	0.607	0.704
FSB2	I have a written annual production plan	0.718	0.571
FSB3	I calculate costs and income before making business decisions	0.678	0.688
FSB4	I optimize the use of production inputs (fertilizers, pesticides) according to needs	0.639	0.588
FSB5	I use technology to increase production volume	0.722	0.619
FSB6	I have contracts or sales agreements with regular buyers	0.137	0.226
FSB7	I actively seek information on coffee prices and markets	0.602	0.564
FSB8	I provide wages to workers according to regional minimum standards	0.645	0.533
FSB9	I provide occupational safety equipment for workers	0.583	0.531
FSB10	I provide periodic occupational safety training	0.601	0.434

FSB11	I am actively involved in farmer groups	0.417	0.555
FSB12	I share knowledge and experience with other farmers	0.410	0.514
FSB13	I involve women in coffee cultivation decision-making	0.242	0.452
FSB14	I provide equal opportunities for female workers	0.357	0.651
FSB15	I implement soil conservation techniques (terracing, rorak/contour trenches, etc.)	0.639	0.592
FSB16	I use an efficient irrigation system	0.577	0.369
FSB17	I process coffee husk waste into organic fertilizer	0.560	0.504
FSB18	I have a wastewater treatment system	0.422	0.134
FSB19	I maintain natural shade trees (e.g., durian, stink bean, banana, dogfruit, and lamtoro) in my coffee plantation	0.096	0.382
FSB20	I do not use pesticides harmful to pollinating insects	0.339	0.155
FSB21	I harvest only ripe red coffee cherries ("selective picking")	0.169	0.357

Remarks: M = Member of group, NM = Non-member of group

4 RESULTS AND DISCUSSION

4.1 Discriminant validity

The Fornell-Larcker criterion (table 3) is a statistical test used to determine discriminant validity. Its purpose is to ensure that each concept (construct) in this study is truly unique and captures something that the other concepts do not

Table 3

Results Fornell-Larcker criterion

Code	FSB		SNORM		SOCNET		STRUST	
	M	NM	M	NM	M	NM	M	NM
FSB	0,520	0,507						
SNORM	0,689	0,737	0,715	0,766				
SOCNET	0,753	0,621	0,768	0,542	0,693	0,651		
STRUST	0,520	0,677	0,770	0,701	0,675	0,476	0,757	0,677

Remarks: M = Member of group, NM = Non-member of group

The HTMT ratio is used to ensure constructs are distinct. For Members, the ratio between SOCNET and SNORM is 1.012, which exceeds the typical threshold of 0.85 or 0.90, suggesting these two categories might be measuring overlapping concepts rather than distinct ones.

Table 4

Results Heterotrait Monotrait Ratio (HTMT)

Code	FSB		SNORM		SOCNET	
	M	NM	M	NM	M	NM
FSB						
SNORM	0,793	0,802				
SOCNET	0,852	0,766	1,012	0,686		
STRUST	0,589	0,741	0,983	0,831	0,838	0,600

Remarks: M = Member of group, NM = Non-member of group

4.2 Convergent validity

The Average Variance Extracted (AVE) tells us this. SNORM, SOCNET, and STRUST all have AVEs that are adequate or close to acceptable. However, FSB (Sustainable Production Behavior) has a relatively low AVE (0.271 for Members and 0.257 for Non-Members). This suggests that the indicators for FSB do not explain a majority of the variance in the construct, which is a statistical concern. The results (table 4) suggest a widespread lack of discriminant validity, particularly among the Member group. This aligns with the HTMT ratio we discussed earlier, where the value between Social Networks and Social Norms was 1.012 (anything over 0.90 indicates the two constructs are likely measuring the same thing).

Table 5*Reliability evaluation*

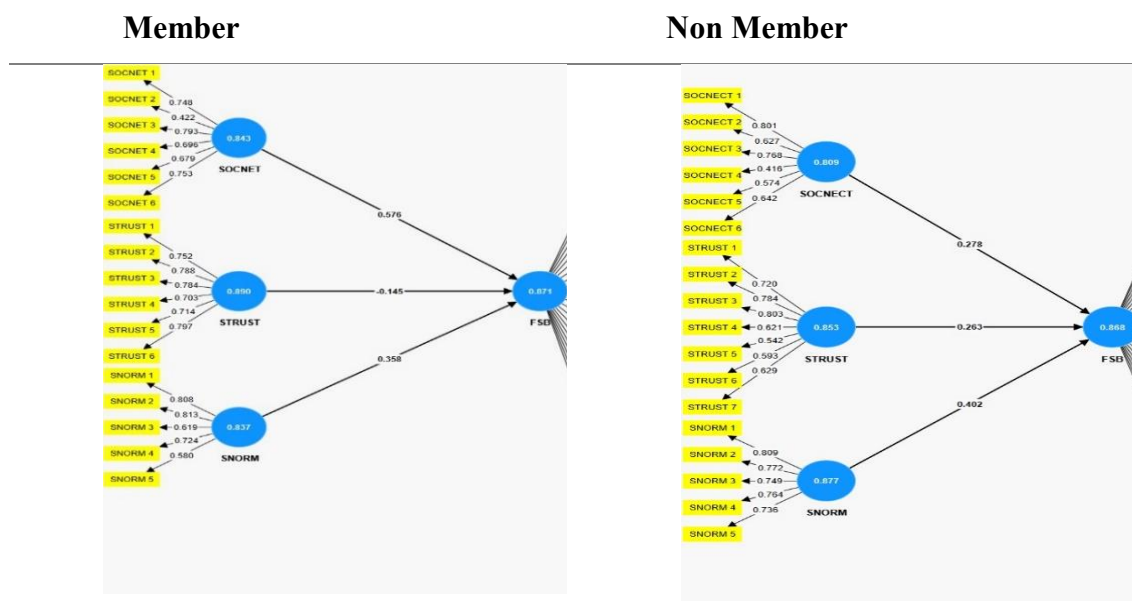
Code	Cronbach's alpha		Composite reliability (rho a)		Composite reliability (rho c)		Average variance extracted (AVE)	
	M	NM	M	NM	M	NM	M	NM
FSB	0.844	0,846	0.877	0,864	0.871	0,868	0.271	0,257
SNORM	0.760	0,824	0.791	0,828	0.837	0,877	0.512	0,587
SOCNET	0.777	0,716	0.806	0,732	0.843	0,809	0.480	0,423
STRUST	0.865	0,802	0.870	0,832	0.896	0,853	0.553	0,458

4.3 Reliability

The constructs were evaluated for reliability using Cronbach's alpha and Composite Reliability (CR) as seen in table 5. All constructs (FSB, SNORM, SOCNET, STRUST) for both groups show good internal consistency, as their Cronbach's alpha and CR values are generally above the 0.70 threshold. The square root of the Average Variance Extracted (AVE) as seen in table 3, which is represented by the values on the diagonal, should be higher than any of the correlation values in the corresponding rows or columns below it. For the construct of Sustainable Production Behavior (FSB), this criterion is not met for either group. In the Member group, the AVE diagonal value is 0.520, but its correlations with Social Norms (0.689) and Social Networks (0.753) are much higher, indicating a lack of discriminant validity. Similarly, for the Non-Member group, the AVE diagonal value is 0.507, while correlations with Social Norms (0.737), Social Networks (0.621), and Social Trust (0.677) all exceed this value.

Figure 2

Comparison of Path model with standardized factor loadings.



The findings indicate that the FSB construct lacks sufficient distinction from other factors, exhibiting considerable overlap with social norms and networks, which implies that the survey questions may not effectively differentiate behavior from social influence. Social Norms (SNORM) and other conceptions also indicate problems. The diagonal value in the Member group is 0.715, which is lower than the values for Social Trust (0.770) and Social Networks (0.768). This means that the discriminant validity is not strong enough. Conversely, in the Non-Member group, the diagonal value (0.766) is higher than its correlations with other constructs, suggesting better differentiation. Similarly, for Social Networks (SOCNET), the construct fails the test in the Member group, with a diagonal value of 0.693 that is lower than its correlation with Social Norms (0.768). However, in the Non-Member group, the diagonal value (0.651) exceeds its correlation with Social Trust (0.476), indicating acceptable discriminant validity. It is also worth noting that some researchers argue that if the Composite Reliability (CR) is high typically above 0.6 or 0.7 then the convergent validity of a construct can still be considered adequate even if the AVE falls below 0.5 (Fornell & Larcker, 1981; Huang *et al.*, 2013).

4.4 Hypothesis testing

The sources (table 6) examine how social factors influence Sustainable Production Behavior (FSB).

- Social Norms (SNORM) → FSB: This relationship is positive and statistically significant for both groups ($p < 0.05$). Social norms have a slightly stronger impact on Non-Members (Path = 0.402) than Members (Path = 0.358).
- Social Network (SOCNET) → FSB: This is a highly significant driver for both groups. However, it is much more influential for Members (Path = 0.576, $p = 0.000$) than for Non-Members (Path = 0.278, $p = 0.001$).
- Social Trust (STRUST) → FSB: There is a major difference here. For Non-Members, trust is a significant positive factor (Path = 0.263, $p = 0.008$). For Members, however, trust has a negative path coefficient (-0.145) and is not statistically significant ($p = 0.301$).

Table 6

Path coefficients and significance for evaluating hypotheses

Path relationships	Original sample (O)		Sample mean (M)		Standard deviation (STDEV)		T statistics (O/STDEV)		P values	
	M	NM	M	NM	M	NM	M	NM	M	NM
SNORM → FSB	0,358	0,402	0,364	0,392	0,140	0,099	2,453	4,075	0,011	0,000
SOCNET → FSB	0,576	0,278	0,564	0,290	0,157	0,087	3,679	3,196	0,000	0,001
STRUST → FSB	-0,145	0,263	-0,114	0,275	0,149	0,099	0,864	2,655	0,301	0,008

Remarks: M = Member of group, NM = Non-member of group

The overall model fit indices indicate that the model may require additional improvement. The model fit indices (table 7) show that the existing model does not suit the data very well. The SRMR (Standardized Root Mean Square Residual) values are 0.121 for the Member group and 0.119 for the Non-Member group. Both of these values are higher than the preferred threshold of 0.08, which means that the model fit is not perfect and that there is room for improvement in model specification. The NFI (Normed Fit Index) values for both groups are both about 0.38, which is very low compared to the

generally acknowledged benchmark of roughly 0.90 for a decent model fit. All of these indices together show that the current model may not accurately reflect the underlying data structure. To get a better match, it may be required to make more changes to the model or try a different modeling strategy.

Table 7

Results Path Coefficients

Abbreviation	Saturated model		Estimated model	
	M	NM	M	NM
SRMR	0.121	0.119	0.121	0.119
d _{ULS}	10.767	11.058	10.767	11.058
d _G	3.909	3.417	3.909	3.417
Chi-square	1800.050	1571.972	1800.050	1571.972
NFI	0.386	0.387	0.386	0.387

Remarks: M = Member of group, NM = Non-member of group

Social networks (SOCNET) demonstrated the strongest influence on sustainable farming behavior (FSB) among group members (path coefficient = 0.576) compared to non-members (0.278), reflecting how organized group structures institutionalize knowledge diffusion, risk-sharing, and collective resource pooling through the integration of bonding, bridging, and connecting social capital in ways that independent farmers cannot replicate on their own. Social norms (SNORM) positively predicted sustainable behavior across both subgroups, and the slightly stronger effect among non-members (0.402 vs. 0.358) indicates that farmers operating outside formal organizations rely more heavily on descriptive norms, drawing behavioral cues from observing successful neighbors in the absence of structured institutional guidance. Social trust (STRUST) significantly enhanced sustainable adoption among non-members (0.263) but proved statistically non-significant and exhibited a negative tendency among group members (-0.145), pointing to a trust paradox whereby formal membership redirects farmers from generalized community trust toward institution-specific mechanisms such as shared rules, verification procedures, and collective agreements. At the measurement level, discriminant validity remained a concern, as the AVE for FSB among members was notably low (0.271) and the HTMT ratio between social networks and norms exceeded 1.0 within the member subgroup, signaling conceptual overlap between social influence and behavioral outcomes in organized farming settings, while the NFI of 0.38 further

indicates that the structural model requires re-specification and potential expansion of latent constructs to more adequately capture the complexity of Indonesian smallholder coffee systems.

5 CONCLUSIONS

The findings collectively underscore that farmer group membership is not merely a demographic attribute but a structural moderator that reconfigures the pathways through which social capital operates. Policy interventions aimed at promoting sustainable coffee farming in Lampung should therefore prioritize strengthening formal farmer associations as institutional platforms for network mobilization. At the same time, normative approaches community campaigns and demonstration practices remain relevant for reaching independent farmers outside formal group structures.

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

DATA AVAILABILITY

The data used to support the research findings of this study are available from the corresponding author upon request.

DECLARATION ON THE USE OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES

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

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