



Stakeholder Support Model for the Sustainable Development of Sigarar Utang Arabica Coffee as Lintong's Territorial Identity in Humbang Hasundutan, Indonesia

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This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

Sigarar Utang Arabica coffee is closely associated with the reputation of Lintong coffee and the territorial identity of Humbang Hasundutan, North Sumatra. Yet its sustainability cannot be defended through origin narratives alone, because the continuity of a local coffee variety depends on farmer incentives, institutional capacity, technical support, market differentiation, and multi-stakeholder coordination. This study analyses the determinants of stakeholder support for the sustainable development of Sigarar Utang as a place-based coffee identity. A quantitative explanatory design supported by field observation was applied to 100 stakeholders selected through stratified purposive sampling with quota allocation. The respondents comprised coffee business actors, coffee farmers, local government or village officials, and farmer-group or cooperative representatives. Data were collected using an 18-item five-point Likert questionnaire measuring regional identity, policy and local institutional support, perceived sustainability benefits, and stakeholder support. Validity testing, construct-level reliability testing, classical assumption tests, and multiple linear regression were performed. The model is statistically significant ($F = 62.453$; $p < 0.001$) and explains 66.1% of the variance in stakeholder support ($R^2 = 0.661$; adjusted $R^2 = 0.651$). Perceived sustainability benefits are the strongest predictor ($\beta = 0.429$), followed by policy and local institutional support ($\beta = 0.301$) and regional identity ($\beta =$

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0.212). The findings indicate that stakeholder support is strongest when Sigarar Utang is framed not merely as a symbolic coffee variety, but as a farmer-centred, institutionally governed, and economically meaningful territorial asset. The article proposes a stakeholder-based conceptual sustainability model integrating identity continuity, farmer sustainability, adaptive variety management, institutional collaboration, functional-area planning, and territorial value-added development.

Keywords: *sustainable coffee; development; local institutions; Humbang Hasundutan, Model*

1. INTRODUCTION

Arabica coffee is more than an agricultural commodity in many highland regions. It carries territorial reputation, production history, social memory, market expectation, and local economic differentiation. In origin-based coffee economies, names such as Gayo, Toraja, Samosir, Java Sindoro-Sumbing, Mandheling, and Lintong function as condensed markers of place, taste, cultivation practice, and collective reputation. This implies that regional development for coffee-producing areas should not be reduced to land allocation or production targets. It must also address the protection of origin-based identity, the sustainability of local varieties, and the institutional arrangements that enable value to remain in the producing territory (Barham, 2003; Bowen, 2010; Giovannucci et al., 2009).

The relevance of territorial identity is particularly strong in specialty-coffee systems. Origin reputation becomes valuable when it is supported by consistent quality, traceable production, collective governance, and producer coordination. However, origin names are fragile. A coffee origin may remain commercially visible even when the local production system that sustains its reputation is weakening. This detachment creates a planning problem: the market may continue to consume the name of a place while the ecological, social, and varietal foundations of that name gradually erode. Regional planning therefore needs to link territorial identity with the material conditions of production, including seed systems, farmer knowledge, post-harvest practice, institutional coordination, and market incentives (Ellyanti et al., 2012; Marbun, 2022).

Humbang Hasundutan Regency, especially the Lintong area, has long been associated with North Sumatra's Arabica coffee reputation. Within this landscape, Sigarar Utang occupies a distinctive position. It is not merely a planting material used by farmers, but a variety associated with the historical development, sensory identity, and public narrative of Lintong coffee. The variety has also been formally released as an Indonesian superior coffee variety through Ministry of Agriculture Decree No. 205/Kpts/SR.120/4/2005. The present study does not claim that Sigarar Utang is a new legal variety right; rather, it treats the variety as a territorial development concern whose sustainability depends on the relationship between farmers, institutions, markets, and local identity (Kementerian Pertanian Republik Indonesia, 2005).

The latest thesis on Sigarar Utang reframes the problem from a narrow conservation issue into a broader stakeholder-support issue. The central question is no longer only whether Sigarar Utang should be protected, but whether the stakeholders who produce, govern, process, trade, and promote coffee perceive sufficient reasons to support its sustainable development. This distinction is important. A local variety can be celebrated in public discourse, yet still decline in farmers' practical decisions if it does not provide acceptable productivity, disease resilience, price incentives, seed quality, or technical support. Conversely, stakeholder support becomes stronger when identity protection is linked to concrete benefits for farmers and the regional economy.

The empirical context of Humbang Hasundutan confirms the need for this broader approach. BPS data for Arabica coffee in Humbang Hasundutan show that Lintong Nihuta remains one of the important coffee-producing districts, but the area and production indicators fluctuate over time. In Lintong Nihuta, Arabica coffee area increased from 2,967.81 ha in 2017 to 3,140.00 ha in 2020, before declining to 2,921.90 ha in 2021. Production increased from 1,674.59 tons in 2017 to 1,879.58 tons in 2020, then declined to 1,649.77 tons in 2021. These figures should not be interpreted as variety-specific evidence for Sigarar Utang alone, because BPS reports Arabica coffee as a commodity category. Nevertheless, the data indicate that the territorial coffee base remains dynamic

and requires careful planning attention (Badan Pusat Statistik Kabupaten Humbang Hasundutan, 2022a, 2022b).

At the village level, the thesis also records an increase in estimated non-Sigarar Utang planting from 51 ha in 2022 to 85 ha in 2025 across 22 villages. This does not necessarily mean that Sigarar Utang is being rejected by farmers. It more accurately signals adaptive varietal diversification. Farmers may maintain Sigarar Utang while also experimenting with other varieties in response to productivity, disease pressure, market access, seed availability, and labour constraints. From a planning perspective, such diversification should not be treated as a simple threat. It should be governed in a way that preserves Sigarar Utang as an identity-bearing variety while allowing farmers to manage agronomic and market risks.

The position of farmers is therefore central. Farmers are not passive recipients of a conservation message. They are the actors who decide what to plant, maintain, rejuvenate, replace, process, or market. If Sigarar Utang is framed only as a symbolic identity, the policy will remain fragile because it may not address the risks and costs borne by farmers. Sustainable development requires a farmer-centred arrangement: access to verified seed, technical assistance, rejuvenation support, pest and disease management, post-harvest improvement, price incentives, and participation in value-added channels. This logic is consistent with studies showing that coffee sustainability is shaped by ecological resilience, social organisation, and economic feasibility (Derisso et al., 2025; Habib & Harada, 2023; Jha et al., 2014; Sia et al., 2025).

The role of local institutions is equally decisive. Government agencies, village authorities, farmer groups, cooperatives, extension officers, roasteries, coffee shops, seed producers, and academic actors influence the way coffee identity is transformed into a development system. Without institutions, identity remains a narrative; with weak institutions, identity can become a market label that is insufficiently protected at the production base. Collaborative planning theory emphasises that development programmes gain legitimacy when affected actors understand their roles and recognise their interests within the planning arrangement (Arnstein, 1969; Healey, 1997). In the Sigarar Utang context, stakeholder support depends on whether local institutions can coordinate seed governance, extension services, quality assurance, branding, and benefit distribution.

Previous studies have examined Indonesian coffee through geographical indications, spatial planning, agropolitan development, agroforestry, risk management, and commodity-based regional development (Budi Nur Sidiq et al., 2024; Fajria et al., 2022; Hakim et al., 2024; Iwan Tona et al., 2023; Murtiningrum & Oktoyoki, 2019; Sanudin, 2021). These studies are valuable, but several gaps remain. First, many studies focus on certification, marketing, or land suitability rather than stakeholder support for a specific local variety as a territorial identity. Second, empirical models often do not combine regional identity, institutional support, and perceived sustainability benefits in explaining stakeholder support. Third, research on Lintong coffee and Sigarar Utang remains limited in explaining how local actors interpret the relationship between variety continuity, farmer welfare, and regional identity. Fourth, the position of farmers as active guardians of identity through cultivation decisions remains underdeveloped in the literature.

This article responds to these gaps by developing a stakeholder-based analysis of sustainable Sigarar Utang development. Its novelty lies in integrating regional identity, policy and local institutional support, perceived sustainability benefits, and stakeholder support into a single explanatory framework, then translating the statistical findings into a conceptual sustainability model. The purpose is twofold: first, to analyse the extent to which regional identity, policy and local institutional support, and perceived sustainability benefits predict stakeholder support; and second, to formulate a stakeholder-based conceptual sustainability model for Sigarar Utang as Lintong's territorial coffee identity.

2. METHODS

2.1 Research design and study area

This study used a quantitative explanatory design supported by field observation. The quantitative component was used to test whether regional identity, policy and local institutional support, and perceived sustainability benefits predicted stakeholder support for the sustainable development of Sigarar Utang. Field observation was used to interpret the statistical results in relation to actual cultivation practices, farmer preferences, institutional arrangements, and the local meaning of Sigarar Utang in the Lintong coffee landscape. The study was conducted in Humbang Hasundutan Regency, North Sumatra, with emphasis on Lintong Nihuta as a historically important locus of Lintong Arabica coffee.

2.2 Population, sampling, and respondent structure

The population of interest consisted of stakeholders connected with the Sigarar Utang coffee system. The population was not defined as the general population of Lintong Nihuta, but as actors with direct or indirect involvement in coffee production, governance, processing, marketing, and local development. Stakeholders included coffee farmers, farmer-group or cooperative representatives, coffee business actors, and local government or village officials. The final sample comprised 100 respondents. Stratified purposive sampling with quota allocation was used because the complete sampling frame of all coffee stakeholders was unavailable, while the research required representation across different actor categories. Respondents were selected based on their relevance, experience, and relationship to the Sigarar Utang or Lintong coffee system.

Table 1. Stakeholder composition of the sample

Stakeholder group	n	%	Analytical relevance
Coffee business actors	32	32.0	Processing, trade, roastery, coffee shop, seed, or value-chain activities
Coffee farmers	29	29.0	Cultivation decisions, variety maintenance, rejuvenation, and farm-level adoption
Local government or village officials	24	24.0	Policy support, extension programmes, local planning, and institutional facilitation
Farmer-group or cooperative representatives	15	15.0	Collective action, farmer organisation, quality control, and market linkage
Total	100	100.0	Multi-stakeholder sample for explanatory analysis

Source: Primary data processed, 2026.

2.3 Measurement and variables

Primary data were collected through a structured questionnaire using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The instrument contained 18 items distributed across four constructs: regional identity (X1; four items), policy and local institutional support (X2; five items), perceived sustainability benefits (X3; four items), and stakeholder support for the sustainable development of Sigarar Utang (Y; five items). The operationalisation was adapted from the thesis framework on territorial identity, local institutions, sustainable coffee development, and stakeholder support. Secondary data were obtained from BPS publications, local agricultural records, legal documents on geographical indications and seed governance, and academic literature on coffee sustainability, territorial development, and participatory planning.

Table 2. Operationalisation of research constructs

Construct	Items	Operational focus	Indicative measurement domains
Regional identity (X1)	4	Stakeholder perception of Sigarar Utang as part of Lintong's distinctive coffee	Historical attachment, origin reputation, pride, perceived

Construct	Items	Operational focus	Indicative measurement domains
		identity and Humbang Hasundutan's territorial reputation.	uniqueness, and identity threat if the variety weakens.
Policy and local institutional support (X2)	5	Stakeholder perception of policy clarity, institutional readiness, and local capacity to support Sigara Utang development.	Government programmes, farmer groups, cooperatives, extension services, inter-actor coordination, and regulatory readiness.
Perceived sustainability benefits (X3)	4	Stakeholder perception of the long-term benefits of Sigara Utang development for farmers, local economy, and territorial competitiveness.	Farmer income, value added, market differentiation, agrotourism potential, environmental-cultural continuity, and future competitiveness.
Stakeholder support (Y)	5	Stakeholder willingness and commitment to support the sustainable development of Sigara Utang as Lintong's coffee identity.	Willingness to maintain Sigara Utang, support programmes, strengthen institutions, support branding, and participate in identity protection.

Source: thesis instrument, 2026.

2.4 Data analysis

Data analysis proceeded through six stages. First, respondent characteristics were tabulated to show the stakeholder profile. Second, descriptive statistics were used to summarise each construct. Third, validity was assessed using corrected item-total correlation; items were considered valid when the value exceeded the r-table threshold of 0.196 at N = 100. Fourth, reliability was tested using Cronbach's alpha at the construct level. Fifth, classical assumptions were examined through normality, multicollinearity, and heteroscedasticity tests. Sixth, multiple linear regression was applied using the model $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$, where Y represents stakeholder support, X1 represents regional identity, X2 represents policy and local institutional support, X3 represents perceived sustainability benefits, a is the constant, b1–b3 are regression coefficients, and e is the residual term. Because the data are cross-sectional and perception-based, the interpretation avoids strong causal claims and uses the language of prediction or statistical association.

3. RESULTS

3.1 Respondent profile

The respondent profile confirms that the study captured a multi-stakeholder structure rather than a farmer-only sample. Male respondents accounted for 81.0% and female respondents for 19.0%. The age distribution was concentrated in productive adult groups, with 36.0% aged 25-34 years and 32.0% aged 35-44 years. Most respondents had sustained involvement in coffee activities: 29.0% had 6-10 years of involvement, 28.0% had 3-5 years, and 24.0% had more than 10 years. Institutional embeddedness was also evident: 45.0% were farmer-group members, 22.0% cooperative members, 15.0% cooperative managers, and 8.0% farmer-group managers. In relation to varietal experience, 52.0% reported having planted or managed Sigara Utang, 32.0% had not, and 16.0% were uncertain about the variety they had planted. This profile is important because stakeholder support is shaped not only by knowledge of the variety, but also by roles in production, institutions, trade, and governance.

Table 3. Selected respondent characteristics

Characteristic	Dominant category	n	%	Interpretation
Gender	Male	81	81.0	The sample reflects the male-dominated structure of local coffee activities.
Age	25-34 years	36	36.0	Respondents were concentrated in productive adult groups.
Coffee involvement	6-10 years	29	29.0	The sample contains substantial practical experience in coffee-related activities.
Coffee institution membership	Farmer-group members	45	45.0	A large proportion of respondents were embedded in local coffee institutions.
Experience with Sigarar Utang	Planted or managed Sigarar Utang	52	52.0	More than half had direct varietal experience.

Source: Primary data processed, 2026.

3.2 Descriptive statistics of research constructs

The descriptive results show that all constructs were rated in the very high category. Regional identity obtained a mean of 4.357, policy and local institutional support obtained 4.338, perceived sustainability benefits obtained 4.360, and stakeholder support obtained 4.358. The closeness of the mean values indicates that stakeholder support is not formed by a single dimension. Instead, it is produced through the convergence of identity, institutions, and perceived benefits. The highest mean was recorded for perceived sustainability benefits, suggesting that stakeholders are most responsive when Sigarar Utang development is perceived to produce long-term economic and territorial value.

Table 4. Descriptive statistics of research constructs

Construct	Mean	SD	Minimum	Maximum	Category
Regional identity (X1)	4.357	0.498	3.00	5.00	Very high
Policy and local institutional support (X2)	4.338	0.479	3.00	5.00	Very high
Perceived sustainability benefits (X3)	4.360	0.469	3.00	5.00	Very high
Stakeholder support (Y)	4.358	0.496	3.20	5.00	Very high

Source: Primary data processed, 2026

3.3 Instrument validity, reliability, and regression assumptions

The measurement instrument met the required statistical criteria. All 18 items were valid, with corrected item-total correlations ranging from 0.429 to 0.682, exceeding the r-table value of 0.196. Reliability was also adequate at the construct level: regional identity (alpha = 0.784), policy and local institutional support (alpha = 0.793), perceived sustainability benefits (alpha = 0.738), and stakeholder support (alpha = 0.807). The regression assumptions were also satisfied. The Kolmogorov-Smirnov significance value was 0.228, indicating normally distributed residuals. Variance inflation factor values were below the conventional threshold, with X1 = 1.799, X2 = 2.212, and X3 = 1.729. The Glejser test indicated no heteroscedasticity problem because all significance values exceeded 0.05.

Table 5. Summary of instrument and assumption testing

Test component	Result	Decision
Item validity	Corrected item-total correlation = 0.429-0.682; r-table = 0.196	All 18 items valid
Reliability X1	Cronbach's alpha = 0.784	Reliable
Reliability X2	Cronbach's alpha = 0.793	Reliable
Reliability X3	Cronbach's alpha = 0.738	Reliable
Reliability Y	Cronbach's alpha = 0.807	Reliable
Normality	Kolmogorov-Smirnov Sig. = 0.228	Normal residual distribution
Multicollinearity	VIF X1 = 1.799; X2 = 2.212; X3 = 1.729	No serious multicollinearity
Heteroscedasticity	Glejser significance values > 0.05	No heteroscedasticity

Source: Primary data processed, 2026.

3.4 Regression results: determinants of stakeholder support

Multiple linear regression produced the equation $Y = 0.540 + 0.264X1 + 0.312X2 + 0.567X3 + e$. The model was statistically significant ($F = 62.453$; $p < 0.001$), indicating that regional identity, policy and local institutional support, and perceived sustainability benefits jointly predicted stakeholder support. The model summary shows $R = 0.813$, $R^2 = 0.661$, adjusted $R^2 = 0.651$, and standard error of estimate = 1.466. Thus, 66.1% of the variance in stakeholder support was explained by the three predictors, while 33.9% was associated with variables outside the model.

Table 6. Multiple regression results

Variable	B	SE	Beta	t	p
Constant	0.540	1.566	-	0.345	0.731
Regional identity (X1)	0.264	0.099	0.212	2.659	0.009
Policy and local institutional support (X2)	0.312	0.092	0.301	3.406	0.001
Perceived sustainability benefits (X3)	0.567	0.103	0.429	5.495	<0.001
Model summary	R = 0.813	R ² = 0.661	Adj. R ² = 0.651	F = 62.453	p = <0.001

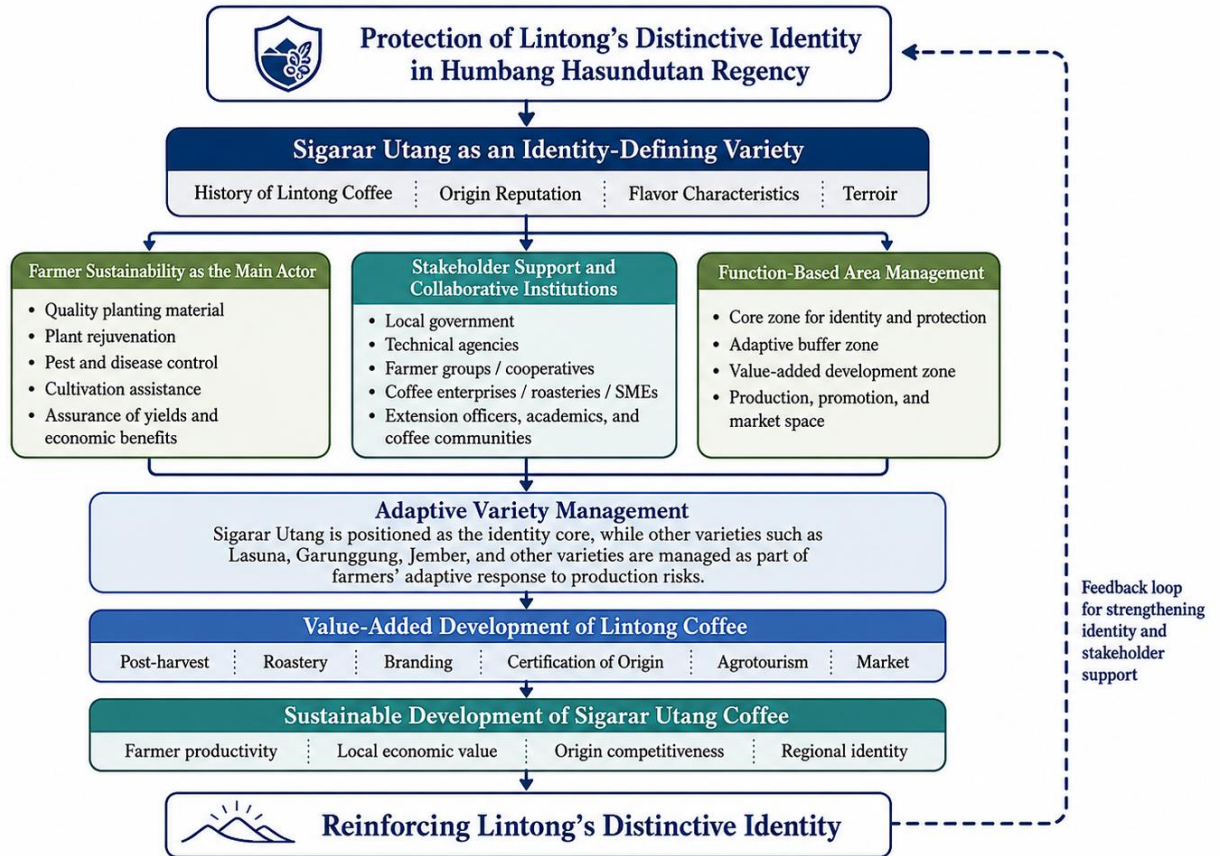
Source: Primary data processed, 2026.

The partial results show that all predictors were positive and significant. Regional identity predicted stakeholder support ($B = 0.264$; $\beta = 0.212$; $p = 0.009$), suggesting that stakeholders who view Sigarar Utang as part of Lintong's distinctive identity are more likely to support its sustainable development. Policy and local institutional support also predicted stakeholder support ($B = 0.312$; $\beta = 0.301$; $p = 0.001$), confirming that support depends on confidence in governance capacity. Perceived sustainability benefits produced the strongest effect ($B = 0.567$; $\beta = 0.429$; $p < 0.001$), indicating that stakeholders respond most strongly when Sigarar Utang development is linked to farmer welfare, local value added, and long-term regional competitiveness.

3.5 Stakeholder-based conceptual sustainability model

The regression results were translated into a stakeholder-based conceptual sustainability model. The model does not treat Sigarar Utang as a static object of preservation. It places the variety within a territorial system composed of identity, farmers, institutions, adaptive varietal management, functional-area planning, and value-added development. In this model, regional identity gives legitimacy; policy and institutions provide coordination; and perceived sustainability benefits create practical motivation for participation. The model is conceptual and policy-oriented; it does not yet define GIS-validated spatial boundaries. Any future spatial application should be validated through participatory mapping, land-suitability assessment, agroclimatic analysis, and verification of planting material.

Figure 1. Stakeholder-based conceptual sustainability model for Sigarar Utang development



Source: Processed by the author, 2026.

Table 7. Components of the stakeholder-based conceptual sustainability model

Model component	Core logic	Implementation direction	Expected output
Lintong territorial identity	Sigarar Utang is positioned as part of the history, reputation, sensory identity, and public image of Lintong coffee.	Strengthen origin document, varietal history, educate stakeholders, and promote Lintong coffee identity.	A clearer and more credible identity base for Sigarar Utang and Lintong coffee.
Farmer sustainability	Farmers are the primary guardians of varietal continuity because varietal decisions are made at farm level.	Provide verified seed, cultivation training, rejuvenation support, pest and disease management, and technical extension.	Farmers have technical and economic reasons to maintain Sigarar Utang.
Adaptive variety management	Sigarar Utang is protected as an identity-bearing variety while other varieties are managed as	Identify Sigarar Utang-dominant farms, manage variety composition, and separate core identity areas from adaptive production areas.	Balance between identity protection and farmers' agronomic adaptation.

Model component	Core logic	Implementation direction	Expected output
	adaptive complements.		
Institutional and stakeholder collaboration	Sustainable development requires coordination among government, farmers, cooperatives, businesses, extension officers, communities, and academics.	Establish coordination forums, farmer groups/cooperatives, integrate local government programmes, and develop partnerships.	More participatory, coherent, and accountable coffee governance.
Functional-area planning	The coffee area is understood as a production, identity, adaptation, and value-added space.	Differentiate core identity functions, adaptive support functions, and value-added development functions through participatory planning.	A more operational basis for spatial and programme intervention.
Territorial value added	Coffee should not remain only a raw commodity but should generate local economic value.	Improve post-harvest handling, quality control, roastery development, coffee centres, agrotourism, certification, branding, and marketing.	Higher local value capture, stronger competitiveness, and wider benefit distribution.

Source: Data Synthesised, 2026.

4. DISCUSSION

4.1 Regional identity as the symbolic foundation of stakeholder support

The significant role of regional identity shows that Sigarar Utang remains meaningful to stakeholders as part of Lintong's territorial coffee reputation. This result is consistent with the literature on origin-based products, where territorial value emerges from the relationship between product, place, history, quality, and collective reputation (Barham, 2003; Bowen, 2010; Giovannucci et al., 2009). In the Sigarar Utang case, identity is not simply a promotional label. It is a social and economic reference point that helps stakeholders understand why the variety matters for Humbang Hasundutan. However, the relatively smaller standardised beta value of regional identity compared with sustainability benefits also indicates that identity alone is insufficient. Stakeholders may respect the symbolic status of Sigarar Utang, but they require practical reasons to translate that respect into support.

This finding has two implications. First, local branding should avoid generic promotion. Sigarar Utang should be communicated through a disciplined origin narrative: where it is cultivated, how it is connected with Lintong coffee, what sensory and historical meanings it carries, and how the local community benefits from maintaining it. Second, identity protection must be connected with quality assurance. If the name of Lintong coffee and Sigarar Utang is used without consistent production and post-harvest standards, the symbolic value of origin can become diluted. Studies on geographical indications show that origin reputation is valuable only when backed by collective governance, traceability, and credible quality systems (Ellyanti et al., 2012; Fajria et al., 2022; Marbun, 2022).

4.2 Policy and local institutions as the governance mechanism

The positive effect of policy and local institutional support confirms that stakeholders do not evaluate Sigarar Utang development only from the perspective of cultural pride. They also ask whether the local system is capable of implementing the agenda. This is a governance question. Stakeholders are more likely to support Sigarar Utang when they perceive that government agencies, village authorities, farmer groups, cooperatives, extension officers, and coffee businesses can coordinate programmes, clarify roles, provide technical services, and reduce uncertainty. In other words, policy support gives formal direction, while local institutions transform that direction into practical action.

This result aligns with collaborative planning theory, which argues that development legitimacy depends on the participation of affected actors and the clarity of institutional arrangements (Arnstein, 1969; Healey, 1997). It also resonates with coffee-sector studies that emphasise the importance of farmer organisations, collective marketing, quality standards, and institutional mediation in improving producer position (Sanudin, 2021). For Sigarar Utang, institutional strengthening should not stop at promotional campaigns. It should include seed governance, extension services, farmer-group revitalisation, cooperative-based post-harvest systems, local government programme alignment, and an explicit coordination forum that brings producers, businesses, government, and knowledge institutions into the same planning structure.

4.3 Sustainability benefits as the strongest determinant

The dominance of perceived sustainability benefits is the most important empirical finding. Stakeholders give stronger support when they believe that Sigarar Utang development can improve farmer welfare, strengthen local value added, enhance market differentiation, and support territorial competitiveness. This finding corrects a common weakness in identity-based commodity planning: the assumption that communities will support a local variety merely because it is culturally important. The data indicate otherwise. Identity provides meaning, but benefits generate durable commitment.

This is particularly relevant for farmers. A farmer's decision to maintain Sigarar Utang depends on productivity, price, disease risk, seed quality, labour needs, and market channels. If a policy asks farmers to maintain Sigarar Utang but does not improve their income security or production resilience, the policy will likely remain symbolic. Therefore, sustainable development should be designed as a package: verified planting material, rejuvenation support, soil and shade management, pest and disease control, processing improvement, quality-based pricing, market linkage, branding, and agrotourism opportunities. Such an integrated approach is consistent with coffee sustainability literature, which stresses the interaction between ecological conditions, economic incentives, and local institutions (Derisso et al., 2025; Habib & Harada, 2023; Latini et al., 2020; Sia et al., 2025; Toledo & Moguel, 2012).

4.4 From conservation planning to stakeholder-based sustainability

A central revision introduced in this manuscript is the shift from a conservation-zoning emphasis to a stakeholder-based sustainability emphasis. The earlier framing risked making the manuscript appear as if it primarily proposed a spatial conservation area. The latest thesis shows a more precise analytical direction: the dependent variable is stakeholder support for the sustainable development of Sigarar Utang, while the conceptual model integrates identity, farmer sustainability, institutional collaboration, adaptive variety management, functional-area planning, and territorial value added. Therefore, the revised manuscript positions zoning or functional-area differentiation only as one component of a broader stakeholder-governance model, not as the entire contribution.

This shift resolves several conceptual weaknesses. First, it avoids overclaiming that spatial zones have been formally validated, because the study does not use GIS, land-suitability modelling, or participatory boundary verification. Second, it aligns the article more closely with the actual quantitative model, where the primary empirical outcome is stakeholder support. Third, it gives farmers and local institutions a clearer position in the model. Fourth, it allows varietal diversification to be discussed more realistically. Other varieties should not automatically be treated as threats; rather, they should be managed through adaptive

variety governance so that farmers can respond to agronomic realities without dissolving the identity value of Sigarar Utang.

4.5 Policy implications

The findings suggest several policy implications for Humbang Hasundutan. First, local government should establish a multi-stakeholder coordination forum for Lintong coffee and Sigarar Utang. The forum should involve farmer groups, cooperatives, extension officers, coffee businesses, village authorities, district agencies, tourism actors, and academic institutions. Its function should not be ceremonial. It should coordinate seed governance, quality control, farmer training, branding, and programme integration.

Second, Sigarar Utang should be strengthened through farmer-centred technical support. Rejuvenation, verified seed access, pest and disease management, cultivation training, post-harvest improvement, and quality-based pricing are necessary to convert identity into farmer benefit. Without farmer benefit, the sustainability model will remain weak even if stakeholder perceptions are currently very positive.

Third, local branding should connect Sigarar Utang with Lintong's territorial identity while maintaining empirical and legal accuracy. The manuscript should avoid claiming new legal plant variety rights. Instead, it should clarify that Sigarar Utang has been formally released as an Indonesian superior variety and that the present policy concern is sustainable territorial development, not a new legal registration process.

Fourth, the functional-area component should be developed cautiously. Core identity areas, adaptive buffer functions, and value-added development functions may be useful for future planning, but they require GIS-based mapping, field verification, participatory boundary discussion, and alignment with regional planning instruments before being treated as formal spatial boundaries.

5. CONCLUSION

This study concludes that regional identity, policy and local institutional support, and perceived sustainability benefits positively and significantly predict stakeholder support for the sustainable development of Sigarar Utang Arabica coffee in Humbang Hasundutan. The model is statistically significant and explains 66.1% of stakeholder support. Among the predictors, perceived sustainability benefits are dominant, followed by policy and local institutional support and regional identity. This pattern demonstrates that Sigarar Utang cannot be sustained by symbolic identity alone. Stakeholders support the variety most strongly when its development is associated with farmer welfare, credible institutional coordination, local value added, market differentiation, and long-term territorial competitiveness.

Ethics and consent statement

The study used questionnaire data from adult local stakeholders. Participation was voluntary, respondents were informed about the academic purpose of the study, and responses were treated confidentially and reported only in aggregate form. No personally identifying respondent information is disclosed in the manuscript. If formal institutional ethics approval was not required under the author's institutional policy for minimal-risk social survey research, this should be stated explicitly in the final submission according to the journal's ethics requirements.

Conflict of interest

The authors declare no conflict of interest.

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