

Pengembangan Desa Berbasis Kopi Robusta melalui Pendekatan Mata Pencaharian Berkelanjutan: Aset Lokal dan Peluang Investasi Hijau di Desa Sabet, Aceh Jaya

Robusta Coffee-Based Village Development Through the Sustainable Livelihood Approach: Local Assets and Green Investment Pathways in Sabet Village, Aceh Jaya

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DOI: <https://doi.org/10.64895/yyv1p377>

Article History

Diterima: 20 April 2026 | Direvisi: 21 April 2026 | Disetujui: 29 April 2026 | Publikasi Online: 30 April 2026

Abstrak

Desa Sabet, Kecamatan Jaya, Kabupaten Aceh Jaya, memiliki potensi yang signifikan untuk pengembangan agroforestri berbasis kopi Robusta dalam kerangka kerja kehutanan sosial. Penelitian ini menganalisis kondisi aset mata pencaharian petani kopi di Desa Sabet menggunakan kerangka kerja Pendekatan Mata Pencaharian Berkelanjutan (SLA) dan mengidentifikasi jalur investasi ramah lingkungan yang dapat memperkuat pembangunan desa berbasis kopi. Desain penelitian campuran (mixed-methods) digunakan, yang menggabungkan survei rumah tangga, wawancara mendalam, dan pengamatan lapangan. Hasil menunjukkan bahwa modal finansial memperoleh skor tertinggi (3,97), diikuti oleh modal fisik (3,53), modal manusia (3,35), modal sosial (2,86), dan modal alam (2,22). Aset utama desa meliputi skor cupping Fine Robusta sebesar 83,00 yang melampaui ambang batas spesialisitas internasional, lembaga lokal yang berfungsi termasuk Lembaga Adat (pemerintahan adat) dan Baitul Mal (keuangan sosial Islam), serta kerangka regulasi yang mendukung berdasarkan Qanun No. 10/2008. Skor modal alam yang rendah menandakan tekanan ekologi yang memerlukan intervensi mendesak melalui praktik agroforestri berkelanjutan. Peluang investasi hijau dari Jepang, yang disalurkan melalui JICA,

Mekanisme Kredit Bersama (JCM), dan kebijakan Transformasi Hijau (GX) Jepang, menawarkan jalur strategis untuk membiayai rehabilitasi lahan dan meningkatkan daya saing kopi Sabet di pasar global. Studi ini merekomendasikan penguatan kapasitas kelembagaan lokal dan pengembangan skema pembiayaan berbasis aset sebagai landasan bagi pembangunan desa yang berkelanjutan.

Kata Kunci: kopi Robusta, agroforestri, mata pencaharian berkelanjutan, aset lokal, investasi hijau jepang, Aceh Jaya

Abstract

Sabet Village, Jaya District, Aceh Jaya Regency, presents significant potential for Robusta coffee-based agroforestry development under social forestry arrangements. This study analyzes the livelihood asset conditions of coffee farmers in Sabet Village using the Sustainable Livelihood Approach (SLA) framework and identifies green investment pathways that can strengthen coffee-based village development. A mixed-methods research design was employed, combining household surveys, in-depth interviews, and field observations. Results indicate that financial capital scored highest (3.97), followed by physical capital (3.53), human capital (3.35), social capital (2.86), and natural capital (2.22). Key village assets include a Fine Robusta cupping score of 83.00 surpassing the international specialty threshold, functioning local institutions including Lembaga Adat (customary governance) and Baitul Mal (Islamic social finance), and a supportive regulatory framework under Qanun No. 10/2008. The low natural capital score signals ecological pressures requiring urgent intervention through sustainable agroforestry practices. Green investment opportunities from Japan, channeled through JICA, the Joint Crediting Mechanism (JCM), and Japan's Green Transformation (GX) policy, offer strategic pathways for financing land rehabilitation and enhancing the competitiveness of Sabet's coffee in global markets. This study recommends strengthening local institutional capacity and developing asset-based financing schemes as the foundation for sustainable village development.

Keywords: Robusta coffee, agroforestry, sustainable livelihoods, local assets, japan green investment, Aceh Jaya

Introduction

Coffee is one of the most globally traded agricultural commodities and plays a major role in rural economies, especially in developing countries where smallholder production dominates. Indonesia is among the world's largest coffee producers, and its Robusta coffee (*Coffea canephora*) is particularly important, representing a dominant share of national coffee production and serving as a key income source for smallholder farmers and rural communities. Recent data indicate that Indonesia produced approximately 774,000–794,000 tonnes of coffee in 2022, with Robusta accounting for

around 72–74% of total coffee production and the remainder mainly Arabica (BPS, 2024; Aeki-AICE, 2023).

Moreover, global production estimates suggest that Indonesia is among the top three Robusta producers, with an estimated 9.3 million 60-kg bags in the 2024/2025 marketing year, accounting for nearly half of global Robusta production outside of Vietnam and Brazil (USDA/Databoks, 2025).

In rural Indonesia, coffee cultivation is predominantly conducted by smallholder farmers on landholdings often less than 2 hectares. These households depend on coffee not only for cash income, but also as a fundamental part of their livelihood portfolios, which include other on- and off-farm activities. However, the contribution of coffee income to household welfare varies widely and is frequently constrained by limited value addition, weak market access, and underdeveloped processing capabilities. For example, recent value chain research in Robusta coffee demonstrates that farmers often receive less than 45% of the final retail value, while processors and intermediaries capture much of the added value due to stronger downstream integration (Widadie et al., 2025).

While agricultural and production improvements have been emphasized in policy and extension programs, coffee-based rural development is shaped by broader livelihood dynamics. Households' ability to transform agricultural resources into sustainable outcomes depends on a diverse set of assets including human skills, social networks, infrastructural support, and financial resources as conceptualized in the Sustainable Livelihood Approach (SLA). SLA highlights that sustainable development is achieved not solely through increased production but through the strategic use and enhancement of livelihood assets in ways that build resilience, reduce vulnerability, and enable adaptation to economic and environmental changes. These assets natural, human, social, physical, and financial interact within institutional and vulnerability contexts to influence livelihood strategies and outcomes. SLA has been widely applied in agricultural research to analyze smallholder resilience and livelihood sustainability in commodity systems (Ramadhan^a et al., 2025; Hartono et al., 2024; Sutrisno et al., 2025; Ramadhan^b et al., 2025).

Recent studies in Indonesia indicate that sustainable livelihood strategies can vary substantially across coffee-producing regions. For example, research in Aceh Tengah shows that sustainable livelihood strategies and institutional coordination influence farmers' opportunities in regional coffee supply chains (Hartono et al., 2024), and social forestry initiatives using SLA frameworks help clarify the conditions supporting community welfare through coffee-based development (Aulia et al., 2025).

National research also underscores that economic viability and household income depend not only on production volumes but on the capacity to innovate in

value addition and marketing, as seen in analyses of Robusta processing enterprises and smallholder economic performance (Utami et al., 2025).

Despite these advances, there remains a lack of focused, empirical research that applies SLA comprehensively to understand how livelihood assets shape sustainable development in Robusta coffee commodity-based villages such as Sabet Village, Aceh Jaya Regency. Identifying the conditions of livelihood assets and how they interact with market structures and institutional contexts is essential for designing development strategies that enhance both household welfare and village resilience. For the community of Sabet Village, the cultivation of Robusta coffee (*Coffea canephora*) serves as the foundational economic engine, providing essential cash income for thousands of households.

Therefore, this study aims to: (1) analyze the configuration of livelihood assets among Robusta coffee farmers in Sabet Village, Jaya District, Aceh Jaya Regency, using the Sustainable Livelihood Approach (SLA) framework; (2) examine the role of local institutional assets – specifically Lembaga Adat (customary governance), Qanun (local regulations), and Baitul Mal (Islamic social finance) – in enabling or constraining sustainable village development pathways; and (3) identify green investment opportunities, particularly those aligned with Japan's JICA programs and Green Transformation (GX) policy, as strategic mechanisms for addressing identified asset deficits and advancing SDG-aligned rural development. By integrating livelihood asset analysis with local institutional conditions and international green investment frameworks, this research contributes empirical insights on how Robusta coffee-based village development can be strengthened in socially equitable, ecologically sound, and economically viable ways (Gutierrez-Montes et al., 2009).

Literature Review

Sustainable Livelihood Approach and Livelihood Resilience

In the last decade, the Sustainable Livelihood Approach (SLA) has evolved from a descriptive framework into a quantitative tool for assessing livelihood resilience under climate change. While the foundational framework proposed by Scoones (1998) remains influential, recent studies emphasize the need to operationalize SLA using measurable indicators and composite indices.

Quandt (2018) introduced the Household Livelihood Resilience Approach (HLRA), which quantifies livelihood capitals and adaptive capacity, enabling cross-site comparison. Subsequent studies applied SLA-based indices to evaluate livelihood resilience in forest-dependent and agricultural communities, demonstrating its robustness in climate-vulnerable regions (Ansoms et al., 2021; Tanner et al., 2015). However, these studies often lack integration with ecological performance indicators, particularly carbon sequestration.

Agroforestry Systems and Climate Resilience

Land Use Management

Agroforestry serves as a versatile and essential approach to enhancing land productivity and efficiency by integrating tree cultivation with conventional farming and in some cases livestock thereby generating a wide range of combined benefits.

Table. Sustainability Impacts of Diverse Agroforestry Systems in Existing Studies

Agroforestry systems	Geographic region	Main component intercrops	Sustainability benefits	Reference
Coffee-based agroforestry	Central America	Coffee + shade trees (<i>Inga</i> spp., fruit trees)	Microclimate regulation, yield stability, livelihood diversification, carbon sequestration	Vaast et al. (2016); Jezeer et al. (2019)
Cocoa agroforestry	West Africa	Cocoa + timber and fruit trees	Biodiversity conservation, household income improvement, soil fertility enhancement	Vaast et al. (2016); Asare et al. (2019)
Silvopastoral agroforestry	Latin America	Pasture + fodder and timber trees	Increased livestock productivity, reduced land degradation, enhanced carbon storage	Cardinael et al. (2018); Griscom et al. (2017)
Mixed tree-crop agroforestry	Sub-Saharan Africa	Maize + leguminous trees	Improved food security, soil nutrient cycling, climate resilience	Zomer et al. (2016); Rosenstock et al. (2019)
Homegarden agroforestry	South and Southeast Asia	Multi-species trees + annual crops	Livelihood resilience, dietary diversity, high	Zomer et al. (2016); Ansoms et al. (2021)

			biomass carbon density	
Coffee-based agroforestry under social forestry	Indonesia	Coffee + multipurpose forest trees	Tenure security, livelihood resilience, increased carbon stocks	Maryudi et al. (2020); Sunderlin et al. (2020)
Climate-smart agroforestry systems	Global (tropics)	Trees + perennial and annual crops	Climate adaptation and mitigation, ecosystem service provision	Griscom et al. (2017); Rosenstock et al. (2019)

Recent literature consistently identifies agroforestry as a nature-based solution (NbS) that enhances climate resilience and livelihood sustainability. Rosenstock et al. (2019) and Zomer et al. (2016) showed that agroforestry systems improve microclimatic regulation, reduce climate risk, and diversify income sources. Coffee-based agroforestry systems are particularly effective in buffering temperature increases and rainfall variability (Jezeer et al., 2019; Vaast et al., 2016).

Despite these advances, many agroforestry studies prioritize biophysical or productivity outcomes, with limited attention to integrated livelihood resilience metrics, indicating a gap between agronomic performance and socioeconomic sustainability.

Social Forestry and Community-Based Forest Management

Over the past decade, social forestry has gained prominence as a governance mechanism for sustainable land use and poverty alleviation. Baynes et al. (2015) and Arts et al. (2017) emphasized that secure tenure and local institutions are critical for achieving positive livelihood and environmental outcomes.

In Indonesia, recent evaluations of social forestry highlight improvements in access rights and income diversification but also note uneven livelihood impacts due to limited market integration and ecosystem valuation (Maryudi et al., 2020; Sunderlin et al., 2020). These findings suggest that incorporating **ecosystem service valuation**, such as carbon storage, could strengthen the economic relevance of social forestry programs.

Local Institutional Governance: Lembaga Adat, Qanun, and Baitul Mal

Acehnese society is governed by a distinctive socio-legal structure rooted in customary institutions known as Lembaga Adat, which function as community-level governance bodies responsible for managing natural resources, mediating disputes, and maintaining social norms. These institutions operate alongside formal government structures and are formally recognized under Qanun Aceh No. 10 of 2008 on Acehese Customs and Customary Institutions, which grants them legal authority to regulate land use, natural resource management, and community welfare at the village and mukim levels (Aulia et al., 2025). The persistence of Lembaga Adat in rural Aceh reflects a broader pattern of community-based governance that predates the formation of the Indonesian state, and its integration with modern development frameworks presents a promising but underexplored pathway in sustainable livelihood research.

Complementing the customary governance structure, Baitul Mal functions as an Islamic social finance institution that manages zakat, infaq, and waqf for community welfare and productive development. In Aceh, Baitul Mal has been institutionalized through provincial and district-level regulations, providing a formal mechanism for channeling social finance toward poverty alleviation and economic development (Hartono et al., 2024). Recent studies indicate that integrating Baitul Mal with community-based livelihood programs could provide alternative financing for agricultural inputs, processing equipment, and capacity-building programs that are otherwise inaccessible to smallholder coffee farmers (Ardina & Yulawati, 2025). However, the potential of these local institutional assets as practical implementation vehicles for aligning smallholder coffee development with international sustainability standards and SDG frameworks remains insufficiently examined in the empirical literature.

Japanese Green Investment and Rural Coffee Development

Japan's development cooperation in Indonesian agriculture has expanded through programs administered by the Japan International Cooperation Agency (JICA), which supports capacity building, market access, and sustainable agricultural development in smallholder systems, with growing emphasis on climate resilience and quality upgrading in commodity value chains (Neilson et al., 2014; Donovan et al., 2019). In the coffee sector, JICA-aligned initiatives have demonstrated potential for linking Indonesian smallholder farmers to Japanese specialty markets by supporting post-harvest quality improvements and traceability systems consistent with Japanese buyer requirements.

Japan's Green Transformation (GX) policy – a national strategy to transition the economy toward carbon neutrality while maintaining industrial competitiveness – has created new opportunities for international partnerships in nature-based solutions and sustainable agriculture. The Joint Crediting Mechanism (JCM), established under

bilateral agreements between Japan and partner countries including Indonesia, enables Japanese entities to fund emissions-reducing projects abroad and claim resulting carbon credits toward Japan's NDC commitments (Maryudi et al., 2020; Sunderlin et al., 2020). Coffee-based agroforestry under social forestry arrangements is recognized as an eligible project type under JCM due to its measurable carbon sequestration potential. Taken together, JICA's capacity-building mandate and the JCM's investment incentives within Japan's GX framework represent a convergent policy landscape that could provide both technical assistance and financial resources to address the structural livelihood constraints identified in SLA-based analyses of Robusta coffee communities.

Synthesis and Research Gap

Previous studies indicate that coffee-based rural development, particularly in Robusta-producing areas, plays a crucial role in sustaining smallholder livelihoods; however, its long-term sustainability is highly dependent on the availability and effective utilization of diverse livelihood assets as conceptualized in the Sustainable Livelihood Approach (SLA). Recent international and national literature highlights that productivity-oriented interventions alone are insufficient to enhance farmers' welfare due to persistent constraints related to market access, limited value addition, institutional weaknesses, and vulnerability to price and climate shocks. Although SLA has been widely applied to analyze coffee farmers' livelihood strategies, most studies focus on household-level outcomes or Arabica-dominated regions and remain largely descriptive, providing limited insight into village-level development dynamics. Moreover, empirical evidence on Robusta coffee-based village development in understudied regions such as Aceh Jaya is still scarce. Furthermore, despite the recognized governance role of local customary institutions such as Lembaga Adat and Qanun in Aceh, their potential as practical implementation vehicles for livelihood development strategies – and their alignment with international sustainability frameworks – remain insufficiently examined in the SLA literature. Similarly, while green investment mechanisms such as Japan's JICA programs, the Joint Crediting Mechanism (JCM), and the Green Transformation (GX) policy represent emerging financing opportunities for Robusta coffee communities, empirical evidence linking SLA-identified asset deficits to these green investment pathways is virtually absent in village-level studies. This study addresses these gaps by applying an integrated SLA framework to examine how livelihood assets – including local institutional assets and green investment readiness – shape sustainable development pathways in a Robusta coffee-based village in Aceh Jaya.

Table. Exploring Challenges in the Adoption of Agroforestry Practices

Author / Study	Location (Country/Region)	Challenges in Adoption of Agroforestry Practices	Source
Masibo et al. (2018)	Chepalungu Forest area, Kenya	Damage by animals & people; tree nursery issues; inadequate capital; natural calamities; competing land uses; managerial problems; seed acquisition problems	Masibo et al. (2018)
Frontiers report (2025)	Northwestern Ethiopia	Lack of cultivated land; pests & diseases; lack of seed supply; limited market access; inadequate infrastructure; competition for light & water	(Ethiopia study)
Juba County study (2025)	South Sudan	Lack of low-cost quality inputs; high insecurity; lack of capital; insufficient labor; land disputes	South Sudan study
Global systematic review (2024)	Africa (multiple countries)	Pests; land access problems; lack of knowledge & skills; lack of capital; lack of seeds	Africa review
Pandey & Agarwal (2022)	Awadh Region, India	Inadequate information & technical knowledge; long gestation periods; limited access to quality planting material; financial constraints	India study
IIED (2025) - global case synthesis	Multiple countries worldwide	Limited awareness; high upfront costs; additional labour requirements; lack of extension support; access to seed issues; insecure land tenure	IIED (2025)

The rationale for integrating Japanese green investment into the Sabet context is rooted in the study's identification of a "partially sustainable" development path, characterized by severe imbalances in natural and social capital. Strategic initiatives like the JICA-ECOM project (JICA, 2025) and the Joint Crediting Mechanism (JCM) offer a targeted solution to these findings by providing the "missing capital" required to rehabilitate aging coffee trees and professionalize farmer organizations (Truong,

2020). This linkage ensures that the findings of the SLA study are not merely diagnostic but serve as a foundation for systemic revitalization through international climate finance and technical cooperation. By integrating the Sustainable Livelihood Framework (SLF) with Japanese green finance mechanisms—such as the Japan International Cooperation Agency (JICA) and the Joint Crediting Mechanism (JCM) — it is possible to develop a holistic model for rural revitalization (Ichihara & Uchida, 2016). This study provides a comprehensive analysis of how Japanese green investment can strengthen the five assets of the Sabet coffee farmers' framework, transitioning the community from a state of partial sustainability toward systemic resilience.

Methods

This study employed a mixed-methods case study design to analyze Robusta coffee commodity-based village development through the Sustainable Livelihood Approach (SLA). The research was conducted in Sabet Village, Jaya District, Aceh Jaya Regency, which was purposively selected due to its high dependence on Robusta coffee as the main livelihood source. Primary data were collected through structured household surveys, semi-structured interviews with coffee farmers, village officials, farmer group leaders, as well as direct field observations. Secondary data were obtained from official statistics, policy documents, and recent peer-reviewed studies on coffee livelihoods and rural development. The analysis was guided by the SLA framework, focusing on five livelihood assets human, natural, financial, physical, and social capital commonly applied in agricultural livelihood studies (Quandt, 2018). Quantitative data were analyzed using descriptive statistics and livelihood asset indexing by standardizing and aggregating asset indicators to identify relative strengths and constraints across asset dimensions, while qualitative data were analyzed using thematic content analysis to explore livelihood strategies, institutional roles, and vulnerability contexts (Creswell & Plano Clark, 2018). Data triangulation was applied to enhance validity and reliability, providing a robust empirical basis for formulating sustainable, asset-based development strategies for Robusta coffee-producing villages.

Results and Discussion

This study presents empirical evidence from primary data collected in Sabet Village, analyzed using the Sustainable Livelihood Approach (SLA) to examine Robusta coffee-based village development. The results indicate that livelihood sustainability in the village is shaped by uneven distribution of livelihood assets, which directly affects household strategies and the broader development trajectory of the village.

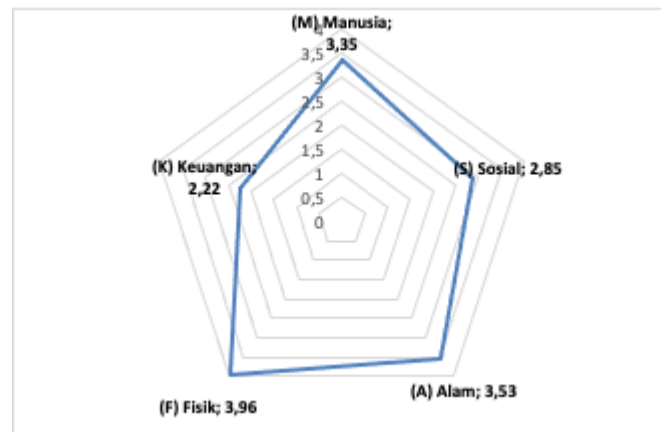


Figure 1. Pentagon SLA Analysis

Quantitative analysis shows that financial capital is the strongest livelihood asset, with an average index score of 3.97. This finding confirms that Robusta coffee farming serves as the main economic backbone for households, providing regular cash income to meet daily needs, education expenses, and limited reinvestment in farming activities. Similar patterns have been reported in recent international studies, which emphasize that coffee income plays a crucial buffering role for smallholder households, despite exposure to price volatility and market uncertainty (Bacon et al., 2017; Donovan et al., 2019). However, heavy dependence on coffee as a single income source also increases vulnerability to external shocks, highlighting the importance of asset diversification.

Physical capital recorded the second-highest score (3.53), reflecting farmers' access to basic production tools, farm access roads, and simple drying facilities. Nevertheless, field observations indicate that post-harvest infrastructure remains largely traditional and fragmented, limiting quality improvement and value addition. This finding is consistent with recent value chain studies in Indonesia, which report that inadequate physical infrastructure constrains farmers' ability to access premium markets and capture higher margins (Widadie et al., 2025).

Human capital achieved an average score of 3.35, indicating moderate capacity derived mainly from long-term farming experience rather than formal training. While experiential knowledge supports production continuity, limited access to structured training and extension services restricts innovation adoption. Evidence from empowerment programs conducted in Sabet Village demonstrates that targeted capacity-building interventions such as selective harvesting, natural post-harvest processing, and digital marketing can significantly enhance coffee quality, achieving red cherry proportions above 80% and a cupping score of 83.00, classified as fine Robusta (Faizin et al., 2025). These results underline the critical role of human capital enhancement in transforming traditional farming systems into more competitive livelihood strategies.

In contrast, social capital (2.86) and natural capital (2.22) were identified as the weakest assets. Low social capital reflects limited participation in farmer organizations, weak collective action, and low bargaining power, resulting in continued dependence on local traders. This finding aligns with studies emphasizing that weak social networks reduce farmers' capacity to negotiate prices, access information, and engage in collective value addition (Neilson et al., 2014; Quandt, 2018). Weak natural capital is associated with land quality constraints, aging coffee trees, limited water availability, and increasing climate variability. Recent studies have highlighted that such ecological pressures pose significant risks to the long-term sustainability of coffee production systems, particularly in tropical regions (Hagggar et al., 2021).

In relation to the research questions, the findings demonstrate that the composition and balance of livelihood assets strongly influence livelihood strategies and village development outcomes. Households with stronger financial and physical capital tend to prioritize production-maintenance strategies aimed at stabilizing yields, rather than pursuing diversification or value-added activities. Conversely, weak social and natural capital limits collective processing initiatives, agroforestry adoption, and institutional strengthening. This supports the core SLA proposition that unbalanced asset portfolios increase vulnerability and constrain sustainable development pathways (Ellis, 2000; Scoones, 1998).

From a village development perspective, Sabet Village exhibits partial sustainability accompanied by structural fragility. While Robusta coffee production contributes significantly to household income and local economic circulation, limited institutional coordination, underdeveloped post-harvest systems, and weak market linkages hinder broader village-level transformation. Comparable studies on Robusta coffee systems in Indonesia report moderate economic sustainability indices (e.g., 58.61, categorized as fairly sustainable), with stronger outcomes observed where agroforestry and institutional support are effectively implemented (Ardina & Yuliawati, 2025). These findings suggest that strengthening social institutions and integrating environmentally adaptive practices are essential to enhance long-term sustainability.

A major strength of this study lies in its use of primary, village-level quantitative data integrated with SLA analysis, providing context-specific insights into Robusta coffee-based village development. However, several limitations should be acknowledged. First, the single-village case study design limits generalizability. Second, the cross-sectional nature of the data does not capture seasonal variations or long-term livelihood dynamics. Third, while SLA effectively captures asset conditions, it does not fully address power relations and policy influences within global coffee value chains (Kaplinsky & Morris, 2001).

As one of Indonesia's primary coffee-producing regions, Aceh's Robusta sector serves as a vital economic backbone, yet it remains precariously exposed to global price fluctuations and accelerating ecological degradation. This study utilizes the Sustainable Livelihoods Framework (SLF) to deconstruct the asset imbalances— notably the disparity between high financial liquidity and low natural-social resilience— that characterize the "partial sustainability" of Sabet Village. Crucially, the analysis is situated within Aceh's unique socio-legal ecosystem, where Qanun regulations and Lembaga Adat (customary institutions) function as the primary, yet underutilized, arbiters of community governance and land management. Reconnecting these localized institutional strengths with international investment standards, specifically Japan's 2026 "Green Transformation" (GX) policies, offers a strategic pathway to align smallholder coffee systems with the 2030 Sustainable Development Goals (SDGs). As of 2025, JCM-linked restoration projects are already operational in Aceh Province in collaboration with social forestry initiatives, with carbon credit issuance projected between 2027 and 2028 (Ministry of the Environment, Japan, 2025). However, it should be noted that these projects primarily focus on peatland and mangrove restoration, and the specific application of JCM to Robusta coffee-based agroforestry systems, such as those in Sabet Village, remains a forward-looking policy recommendation rather than an established practice. Realizing this potential will require dedicated methodology development and institutional alignment between Japanese green investment frameworks and local governance structures in Aceh (Ministry of the Environment Japan, 2025).

4.1. The Livelihood Pentagon: Identifying the "Production-Maintenance" Trap

The quantitative analysis reveals a highly asymmetrical livelihood pentagon, characterized by a dominant Financial Capital (3.97) and a critically constrained Natural Capital (2.22). This imbalance suggests that while Robusta coffee serves as a potent economic engine for Acehese households— providing essential liquidity for daily consumption and education— it operates within a framework of "structural fragility."

The high index for Physical Capital (3.53), primarily reflecting basic farm access and traditional drying tools, is insufficient to catalyze a transition toward high-value markets. Instead, households appear locked in a production-maintenance strategy, where financial gains are reinvested into maintaining current yields rather than pursuing the value-added innovations required for "Fine Robusta" standards. This finding reinforces the SLA proposition (Ellis, 2000) that asset portfolios lacking internal synergy increase vulnerability to external market shocks and climate variability.

4.2. Human Capital and the Threshold of Innovation

With a Human Capital index of 3.35, the labor force possesses significant experiential depth but lacks the formal technical training necessary for systematic quality upgrades. However, the evidence from Sabet Village—where targeted interventions pushed cupping scores to 83.00—demonstrates a high "elasticity of improvement." For international investors, particularly Japanese specialty roasters, this represents a significant opportunity. By aligning with SDG 4 (Quality Education) and SDG 8 (Decent Work), Japanese AgTech and training modules can bridge the gap between traditional knowledge and the precision required for the 2026 global specialty market.

4.3. Reconfiguring Social Capital through "Lembaga Adat" and "Qanun"

The most significant barrier to sustainability is the deficit in Social Capital (2.86). The current "low-trust equilibrium" forces farmers into passive, price-taking relationships with local intermediaries. To overcome this, the research proposes a "Socio-Legal Implementation Vehicle" that reconnects Acehese customary institutions (Lembaga Adat) with Japanese ESG frameworks.

By leveraging Qanun No. 10/2008 and the authority of the Imeum Mukim, the "Social Capital" pillar can be transformed from a weakness into a geographical-institutional asset (Nurdin *et al.*, 2021). This framework offers Japanese investors—specifically those aligned with Green Transformation (GX) policies—a verified, traceable, and culturally anchored supply chain. Such a partnership fulfills SDG 17 (Partnerships for the Goals) by creating a hybrid governance model that blends Japanese corporate discipline (Kaizen) with Acehese communal resilience (Gotong Royong).

4.4. Natural Capital and the Climate-Investment Nexus

The fragility of Natural Capital (2.22), exacerbated by aging coffee trees, land quality constraints, limited water availability, and increasing climate variability, represents the greatest long-term risk to the sustainability of Sabet's coffee livelihoods. Addressing this requires a departure from "business-as-usual" farming practices. Integrating external investment mechanisms—such as those aligned with the Japan International Cooperation Agency (JICA) and Japan's Green Transformation (GX) policy—with local institutional resources such as Baitul Mal (Islamic Social Finance) could provide the capital required to implement coffee-based agroforestry under social forestry arrangements, which have been identified as effective for tenure security, livelihood resilience, and increased carbon stocks in Indonesia (Maryudi *et al.*, 2020; Sunderlin *et al.*, 2020). Strengthening Natural Capital through these mechanisms is essential for rehabilitating degraded agricultural assets and enabling long-term ecological and economic resilience.

While Japanese green investment mechanisms such as JICA and JCM offer promising financial pathways for addressing natural capital deficits in Sabet Village, the practical channeling of such investment requires careful consideration of local institutional intermediaries. Baitul Mal, as a formally institutionalized Islamic social finance body in Aceh, presents a viable vehicle for directing green investment funds toward agricultural rehabilitation and agroforestry inputs at the community level. Similarly, the Mukim, as a legitimate customary governance unit under Qanun No. 10/2008, can serve as the primary platform for community consent formation and project accountability, which are prerequisites for JCM project registration. Together, these local institutions could provide Japanese investors with a traceable, culturally grounded, and governance-backed implementation structure – elements increasingly required under Japan's GX-ETS framework for credible carbon credit issuance.

It should be acknowledged, however, that the integration of JCM financing with Baitul Mal and Mukim governance structures remains a conceptual pathway at this stage. Empirical validation through pilot projects will be necessary to demonstrate feasibility. Furthermore, Fine Robusta coffee from Sabet Village, having achieved a cupping score of 83.00, presents a compelling entry point for Japanese specialty coffee buyers and ESG-oriented investors. However, market awareness of Fine Robusta in Japan remains extremely limited, suggesting that certification and branding mechanisms – potentially informed by local institutional assets – will be essential preconditions for market integration (Ministry of the Environment Japan, 2025).

To advance from a conceptual framework to an operational model, a pilot-scale implementation could be considered. This may include a limited number of smallholder farmers, a defined agroforestry area, and the establishment of MRV protocols aligned with JCM requirements. Importantly, such a pilot could also integrate local institutional mechanisms, particularly Baitul Mal for financial intermediation and Mukim for community-level governance and consent formation, in order to enhance both cultural legitimacy and implementation feasibility. This approach may provide an empirical basis for evaluating the applicability of Japanese green investment frameworks to coffee-based agroforestry systems.

Conclusion

The integration of Japanese green investment frameworks – particularly the Joint Crediting Mechanism (JCM) and Green Transformation (GX) policy – with Sabet Village's coffee-based development represents a strategically significant but as yet unrealized opportunity. While JCM-linked projects are already operational in Aceh Province within social forestry contexts, their specific application to Robusta coffee agroforestry systems remains at the recommendation stage and will require dedicated institutional development and methodology validation before becoming actionable.

Looking ahead, several research and practical pathways merit further exploration. First, the role of local institutions – particularly Baitul Mal and Mukim – as implementation intermediaries for Japanese green finance deserves empirical investigation through pilot projects. Second, the market potential of Fine Robusta in Japan, where awareness remains extremely limited despite its quality credentials, warrants systematic market research and trial distribution to assess consumer and buyer receptivity. Third, the relationship between local certification systems and branding mechanisms – drawing on both Acehese institutional assets and international sustainability standards – presents a promising avenue for future research that could bridge the gap between smallholder coffee quality and global market integration.

These directions collectively suggest that the pathway from partial sustainability to systemic resilience in Sabet Village will depend not only on policy alignment and investment readiness, but on sustained interdisciplinary collaboration between field researchers, local institutions, and international partners committed to equitable and ecologically sound rural development.

Acknowledgments. We acknowledge the use of ChatGPT-4.5 (OpenAI) for language editing and improving the clarity and readability of this manuscript.

Disclosure statement. No potential conflict of interest was reported by the author(s).

Funding. The research and publication of the article originated from funding based on the 2025 Funding Contract “Strategic Research Collaboration Scheme, Title: Climate-Resilient Coffee Agroforestry-Based Social Forestry Model as a Basis for Developing Carbon Economic Value in Aceh Province, and Based on Decree Number: 117/C3/DT.05.00/PL/2025 and Agreement/Contract Number 05/UN59.L1/AL.04/PL/2025 received a Research Grant from the Directorate of Research and Community Service (DPPM) of the Ministry of Higher Education, Science, and Technology, Republic of Indonesia.

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