ASIAN JOURNAL OF AGRICULTURE
Volume 10, Number 1, June 2026
Pages: 6

E-ISSN: 2580-4537
https://doi.org/10.13057/asianjagric/g100117

Carbonic maceration as a value creation strategy for geographical indication coffee in Indonesia

HALIL♥, KURNIAWAN M. NUR, DRIYANTO WAHYU WICAKSONO
Department of Agriculture, Politeknik Negeri Banyuwangi. Jl. Raya Jember Km. 13, Kawang, Labanasem, Kabat, Banyuwangi 68461, East Java, Indonesia. Tel.: +62-333-636780, ♥email: halil@poliwangi.ac.id

Manuscript received: 20 October 2025. Revision accepted: 15 February 2026.

Abstract. *Halil, Nur KM, Wicaksono DW. 2026. Carbonic maceration as a value creation strategy for geographical indication coffee in Indonesi. Asian J Agric 10 (1): g100117. https://doi.org/10.13057/asianjagric/g100117.* Carbonic Maceration (CM) has emerged as a promising post-harvest innovation for speciality coffee, yet evidence on its economic contribution at the farm level remains limited. This study analyses the economic impact of applying Carbonic Maceration (CM) post-harvest technique to Ijen-Raung Arabica coffee, a Geographical Indication (GI) protected commodity from Bondowoso, Indonesia. Using a quantitative approach, data were collected from 15 farmers within the Bondowoso GI Protection Association (PMPIG) during June-August 2025. The analysis integrated Economic Value Added (EVA) and Hayami Method frameworks to assess financial performance, value creation, and income distribution. Results demonstrate that CM generates substantial economic value, with an EVA of IDR 5,946,424.74 per hectare annually, confirming genuine value creation beyond cost of capital. Hayami's analysis revealed the added value of IDR 36,511.25±4,810.85 per kg (45.13±3.49% ratio), with 70.45±11.36% distributed as labour income, underscoring both profitability and equitable rural development. A critical finding was the 20.63% mass loss before processing, reducing the overall harvest-to-bean conversion to approximately 49.21%, highlighting the need for supply chain optimisation alongside CM adoption. The research novelty lies in its integrative methodology, being the first to combine EVA and Hayami Method to empirically quantify economic returns of post-harvest innovation in a GI coffee system. These findings highlight carbonic maceration as a viable post-harvest strategy for value enhancement and recommend broader adoption supported by capacity building, financial access, and quality-based market linkages.

Keywords: Arabica coffee, carbonic maceration, economic value added, geographical indication, supply chain

Abbreviations: CM: Carbonic Maceration, EVA: Economic Value Added, GI: Geographical Indication, PMPIG: Association for the Protection of Geographical Indications Bondowoso

INTRODUCTION

Coffee is a vital global commodity that supports the livelihoods of millions of smallholder farmers in tropical regions (Neilson 2007). However, the sector is characterised by significant price volatility and systemic oversupply, often resulting in farm incomes falling below subsistence levels and creating pervasive economic vulnerability (Kilian et al. 2006). In this challenging landscape, product differentiation through quality enhancement has emerged as a critical strategy to escape the low-price commodity trap. Geographical Indications (GIs) serve as a powerful tool in this regard, functioning not only as a legal protection for place-based products but also as an instrument for building collective reputation, facilitating market access, and securing premium prices (Teuber 2010; Belletti et al. 2017; Török et al. 2020). Indonesia, as a major coffee producer, possesses significant potential for such differentiation, exemplified by the Ijen-Raung Arabica coffee from Bondowoso, East Java, Indonesia, which has obtained GI certification (Wibowo et al. 2021). The granting of GI status is theoretically expected to catalyse rural development by protecting the economic value inherent in unique "terroir" characteristics (Bowen 2010; Yin et al. 2024).

Despite the theoretical promise of GIs, certification alone often proves insufficient to guarantee tangible improvements in farmer welfare. In the case of Ijen-Raung, despite GI recognition since 2018, significant economic enhancement for farmers has not been fully realised (Herminingsih et al. 2023). The core problem lies in the challenge of translating the potential value conferred by GI status into sustained economic value at the farm level. This requires more than a label; it demands concrete operational strategies and quality-enhancing innovations within the value chain to justify premium pricing (Barjolle et al. 2017). Without such innovation, GI products risk remaining symbolic, failing to deliver the anticipated financial returns to producers.

A critical gap exists in the empirical understanding of how specific post-harvest innovations directly catalyse economic value creation within certified GI supply chains. While recent research has explored the sensory and microbiological impacts of novel fermentation techniques like Carbonic Maceration (CM), showing that it enhances flavour complexity and sensory profiles in coffee (Junior et al. 2021; Várady et al. 2022; Da Silva et al. 2023), the direct economic impact remains underexplored. Most existing studies focus either on the agronomic/quality aspects of CM or on the general socioeconomic effects of

GIs, but rarely integrate the two to provide a quantitative, micro-economic assessment of how an innovation like CM translates into value added, profit, and viable returns on investment for farmers. There is a distinct lack of empirical studies that measure the creation and distribution of economic value generated by such post-harvest innovations in the context of high-value, GI-branded agricultural products.

To address this gap, this study aims to conduct a comprehensive economic analysis of the application of the carbonic maceration technique on Ijen-Raung Arabica coffee. The primary objective is to quantify the economic value added generated by CM, moving beyond simple profitability to assess its true value creation potential and its impact on income distribution at the farmer level.

The novelty of this research lies in its integrative analytical framework. This methodological combination is necessary because EVA definitively measures economic sustainability by revealing whether the profits generated truly exceed the cost of capital, thus answering the question of genuine value creation. Simultaneously, the Hayami method complementarily dissects how that value is created and distributed, particularly the proportion allocated to labour, thereby providing empirical evidence of the innovation's impact on farmer welfare and equitable rural development. It is the first study to concurrently apply the Economic Value Added (EVA) methodology-a comprehensive financial performance metric from corporate finance that accounts for the cost of all capital (Kyriazis and Anastassis 2007)-and the Hayami Method-an established approach in agro-industrial analysis for dissecting value addition and factor distribution (Taufiqurrahman et al. 2020). This dual-method approach allows for a holistic assessment: the Hayami Method reveals the efficiency of the value creation process and its distribution between labour and capital, while the EVA calculation determines whether the business generates a genuine economic profit after covering all operational and capital costs. This provides a far more robust and nuanced understanding of economic sustainability and impact than conventional analysis.

This research is designed to precisely measure the economic value added, profit margins, and capital efficiency of applying CM to GI Ijen-Raung coffee. We hypothesise that carbonic maceration produces higher economic value than conventional processing methods by reducing mass loss, improving the conversion factor, and generating positive value addition and EVA for smallholder farmers. By integrating the EVA and Hayami methods, it is expected to provide definitive, empirical evidence on whether this post-harvest innovation creates actual economic value for farmers. The anticipated contribution is twofold: Firstly, it will offer a novel methodological framework for evaluating agricultural innovations. Secondly, it will yield concrete evidence to inform the decisions of farmers, cooperatives, and policymakers regarding investments in post-harvest technology, thereby bridging the critical gap between GI certification and tangible economic prosperity for smallholder farmers.

MATERIALS AND METHODS

Research object

The research was conducted in Bondowoso District, East Java, Indonesia, which is the centre of Ijen-Raung Arabica coffee production that has obtained Geographical Indication certification. The research population was defined as active member farmers of the Bondowoso Geographical Indication Protection Community Association (PMPIG).

The sampling technique used was purposive sampling. The unit of analysis for this study was the individual coffee farmer. The sample inclusion criteria were: (i) Be an active member of a farmer group registered with PMPIG Bondowoso; (ii) Availability of complete and verifiable financial and production records for the preceding two full production years (2023 and 2024) and the current season (2025). The specific financial documents required for analysis included: production cost records for inputs like fertilizers and pesticides; detailed labour logbooks for post-harvest activities; sales invoices for both raw cherries and processed green beans; and capital asset registers for fixed equipment, all essential for the Hayami and EVA calculations; (iii) Actively engaged in the post-harvest process of coffee (at least up to the green bean stage); (iv) Compared farmers with more than 10 years of individual experience in coffee cultivation; (v) Willing to participate fully in the research. Based on these criteria, 15 farmers were selected as respondents for the study.

A structured questionnaire was developed with reference to the literature on value added and financial analysis of farming businesses (Taufiqurrahman et al. 2020; Wibowo and Palupi 2022; Halil et al. 2024). The questionnaire instrument was validated by two experts in agribusiness and agricultural economics. Before widespread use, preliminary tests and studies were conducted to ensure the instrument was appropriate for the local context and easy for respondents to understand. Before data collection, the questionnaire underwent a pilot test with five coffee farmers from the PMPIG association who were not included in the final sample. This process aimed to assess the instrument's clarity, relevance, and contextual appropriateness. Based on the feedback, minor adjustments were made to the wording of several questions to enhance comprehension and ensure the terminology aligned with local farming practices. The applied Carbonic Maceration protocol involved fermenting a batch consisting of ≥95% red cherries in sealed tanks for 48 hours at ambient temperature, maintaining a pH range of 5.5-6.0. The process continued with pulping, washing, hulling, and drying until the green beans reached a final moisture content of 10-12 %. The final questionnaire included sections to collect data on: (i) Production costs (inputs, labour); (ii) Revenue and selling prices; (iii) Input volume (cherry raw materials) and output volume (green bean CM); (iv) Financial data of farmers. Data collection was conducted from June to August 2025 through face-to-face interviews with the 15 sampled farmers.

Data analysis

Data was analysed using two primary methods:

Economic Value Added (EVA): Calculated based on the financial statements of farmers.

NOPAT, the core profit metric in the EVA framework, represents a company's operating profit after taxes, while WACC is the average cost of all capital used to finance its assets and serves as the hurdle rate for EVA calculations (Kyriazis and Anastassis 2007). It is calculated as the weighted average of the cost of debt and the cost of equity:

WACC = (D/V) × rd + (E/V) × re

Where, D: value of debt, E: value of equity, V: total capital (D+E), rd: after-tax cost of debt, and re: cost of equity.

Formula: EVA = NOPAT - (Invested Capital * WACC) (Kyriazis and Anastassis 2007).

Hayami method

Used to analyse the added value, efficiency, and income distribution from processing coffee cherries into green beans using the CM technique, which was analysed using the Hayami method (Hayami et al. 1987). The analysis was conducted per kilogram of raw material (coffee cherries), and the specific calculation steps, adapted to this study's context, were as follows:

Conversion Factor (D = A/B): Calculated as the ratio of output (A: kg of green beans) to input (B: kg of coffee cherries), determining the technical efficiency of the CM process.

Labour Coefficient (E = C/B): Determined as the total labour input (C: in HOK - Person-Days) required per kilogram of raw material (B).

Output Value (J = D × F): The value of the final product per kg of raw material, obtained by multiplying the conversion factor (D) by the price of the output (F: IDR/kg of green beans).

Value Added (K = J - H - I): The core economic benefit created by the CM process, calculated as the output value (J) minus the cost of raw materials (H: IDR/kg of cherries) and other inputs (I: IDR/kg).

Value Added Ratio (L = (K/J) × 100%): The proportion of the output value that constitutes value added, indicating the process's efficiency.

Labour Income (M = E × G): The share of value added distributed to labour, calculated by multiplying the labour coefficient (E) by the wage rate (G: IDR/HOK).

Labour Share (N = (M/K) × 100%): The percentage of the total value added allocated to labour income.

Profit (O = K - M): The remainder of the value added after labour payment, representing the return to capital and entrepreneurship.

Profit Margin (P = (O/K) × 100%): Profit expressed as a percentage of the total value added.

These steps provided a systematic breakdown of how the final output value was created and distributed, with the results presented in Table 2.

RESULTS AND DISCUSSION

General description of the sample

All 15 farmers in the sample have implemented the CM technique in their post-harvest process. The average area cultivated is 1.59±0.06 hectares. All farmers have access to markets that value the quality of CM coffee, with green bean selling prices higher than those of conventionally processed coffee.

Economic Value Added (EVA) analysis

The economic value creation from applying Carbonic Maceration to Ijen-Raung coffee was evaluated using the Economic Value Added (EVA) framework. The analysis was based on operating profit derived from the Hayami method (IDR 11,046.18±5,115.26 per kg of green beans), scaled to a per-hectare basis using average production yield, to establish a Net Operating Profit After Tax (NOPAT) of IDR 7,836,891.41±3,160,624.42 per hectare. This methodological conversion is valid as the Hayami profit already deducts all operating costs, including the depreciation of fixed assets embedded within 'other input contributions' (Variable I). The NOPAT calculation justifiably excludes income tax, as smallholder farmer businesses are effectively tax-exempt under the final income tax regime (0.5% of gross circulation) stipulated in Indonesia's Harmonised Tax Law (Law No. 7 of 2021) for businesses with annual turnover below IDR 4.8 billion (Government of Indonesia 2021). The Weighted Average Cost of Capital (WACC) was estimated at 7%, reflecting a capital structure of 50% debt at a 6% cost (based on the People's Business Credit/KUR-*Kredit Usaha Rakyat* rate) and 50% equity with an 8% opportunity cost.

With an average invested capital of IDR 27,006,666.67±1,648,578.03 per hectare, the annual cost of capital was IDR 1,890,466.67. The EVA was therefore calculated as follows:

EVA = NOPAT - (Invested Capital × WACC)

EVA = IDR 7,836,891.41 - IDR 1,890,466.67 = IDR 5,946,424.74 per hectare.

Given that the underlying operating profit (IDR 11,046.18±5,115.26 per kg) was derived from the Hayami analysis, which showed consistent results across respondents (as indicated by the low standard deviations in Table 2), this positive EVA demonstrates robust value creation. This substantial positive EVA indicates that the business generates a genuine economic profit that exceeds the compensation required for all capital providers, confirming true value creation beyond mere accounting profitability.

To assess the robustness of this finding, a sensitivity analysis was conducted on key financial assumptions (Table 1). The EVA remains strongly positive under less favorable conditions, including a 2-point increase in WACC to 9% and a 10% decrease in the output price, which reduces NOPAT. This consistency confirms the resilience of the value creation potential inherent in the CM technique for GI coffee production.

Table 1. Sensitivity of EVA (IDR/hectare)

Scenario	Change	WACC	NOPAT	EVA
Base Case	-	7%	7,836,891.41	5,946,424.74
Higher Cost of Capital	WACC +2%	9%	7,836,891.41	5,406,290.67
Lower Output Price	Price -10%	7%	7,053,202.27	5,162,735.60
Higher Labour Cost	Labour Cost +15%	7%	6,661,357.70	4,770,891.03
Combined Adverse Conditions	WACC +2%, price -10%	9%	7,053,202.27	4,622,601.93
Severe Market Downturn	WACC +3%, price -20%	10%	6,269,513.13	3,568,847.20

Note: Results of EVA data analysis in 2025

Table 2. Hayami value added with carbonic maceration (per kg of raw material)

Variable	Code	Equation	Value	Unit
Output, Input, and Price				
Output	A	-	31.00±2.59	kg
Input	B	-	50.00±2.75	kg
Labour	C	-	12.00±1.77	HOK
Conversion factor	D	A/B	0.62±0.04	-
Labour coefficient	E	C/B	0.24±0.04	HOK/kg
Output price	F	-	130,000.00±845.15	IDR/kg
Labour wages	G	-	106,000.00±534.52	IDR/HOK
Revenue and Profit				
Raw material price	H	-	20,000.00±1,210.08	IDR/kg
Other input contributions	I	-	24,080.00±678.44	IDR/kg
Output value	J	D × F	80,591.25±4,916.21	IDR/kg
a. value added	K	J - H - I	36,511.25±4,810.85	IDR/kg
b. value added ratio	L	(K/J) × 100%	45.13±3.49	%
a. Labour income	M	E × G	25,465.07±3,751.51	IDR/kg
b. Labour share	N	(M/K) × 100%	70.45±11.36	%
a. Profit	O	K - M	11,046.18±5,115.26	IDR/kg
b. Profit margin	P	(O/K) × 100%	29.55±11.36	%
Margin	Q	J - H	60,591.25±4,784.84	IDR/kg
Direct labour income	R	(M/Q) × 100%	42.10±5.98	%
Contribution of other inputs	S	(I/Q) × 100%	39.98±3.37	%

Note: Results of data analysis using the Hayami method in 2025

Hayami method analysis

The results of the value-added calculation using the Hayami Method are presented in Table 2. Based on the Hayami method analysis, the carbonic maceration process demonstrates efficient resource transformation. The system begins with an input of 50.00±2.75 kg of coffee cherries, valued at IDR 20,000.00±1,210.08 per kg. This input is processed using 12.00±1.77 person-days of labour (HOK), resulting in a labour coefficient of 0.24±0.04 HOK per kg of raw material, which indicates a moderately labour-intensive process. The operation successfully converts the cherries into 31.00±2.59 kg of green beans. The output commands a significant market value, with processed green beans selling for IDR 130,000.00±845.15 per kg, yielding a total output value of IDR 80,591.25±4,916.21 per kg of raw material when the conversion rate is applied.

A critical pre-processing observation was noted: significant mass loss occurs between harvest and processing. Freshly harvested coffee cherries at the plantation weigh an average of 63.00±3.74 kg. However, upon arrival at the processing facility (after approximately 3 hours of transport and 5 hours of harvest), their mass averages 50.00±2.75 kg. This 20.63% mass loss is due to water evaporation and physical handling during the 8-hour interval. Therefore, the subsequent value-added analysis uses a baseline input mass of 50.00±2.75 kg (B) to reflect the actual mass of raw materials at the processing point, ensuring the financial analysis is based on operational reality.

Discussion

A positive and significant EVA value of IDR 5,946,424.74 per hectare per year strongly confirms that the application of Carbonic Maceration (CM) to Ijen-Raung coffee creates genuine economic value, generating returns that exceed the minimum expectations of capital providers (Kyriazis and Anastassis 2007). This finding is pivotal as it shifts the performance paradigm for smallholder agriculture from mere accounting profit-which can mask the actual cost of embedded capital-to a metric of true value creation, providing a more accurate picture of long-term financial sustainability and investment attractiveness (Cucagna and Goldsmith 2018). This robust EVA signals that the business is not just viable but is actively enriching the farmer community beyond a subsistence level. Within the Sustainable Livelihoods

Framework, this positive EVA directly strengthens financial assets, which in turn enhances household resilience to economic shocks and price volatility (Darnhofer 2014; Cinner and Barnes 2019). More importantly, it provides a solid foundation for reinvestment into other critical livelihood assets: natural capital (e.g., investing in soil health and shade-tree management), human capital (e.g., funding further training and education), and physical capital (e.g., acquiring more efficient processing infrastructure) (Folke 2006). This finding empirically aligns with broader evidence that Geographical Indications (GIs) can significantly increase profitability, but only when coupled with appropriate operational innovations that tangibly improve quality and justify premium pricing (Poetschki et al. 2021; Li et al. 2024). Thus, CM acts as the crucial technical catalyst that actualises the latent value of the GI certification, effectively transforming a static comparative advantage (the "terroir") into a dynamic and sustainable competitive advantage in the marketplace (Belletti et al. 2017).

The production process demonstrates robust efficiency and value creation. The conversion factor (D) of 0.62±0.04 indicates satisfactory technical efficiency in transforming cherries into green beans. This process generates a substantial added value (K) of IDR 36,511.25±4,810.85 per kg, with a remarkably high value-added ratio (L) of 45.13±3.49%. This confirms that nearly half of the final product's value is generated by the CM process itself, underscoring the effectiveness of a quality-based differentiation strategy (Taufiqurrahman et al. 2020; Lestari et al. 2021).

However, the interpretation of the conversion factor (0.62±0.04) requires critical contextualization. This figure is based on the mass of cherries at the processing facility (50.00±2.75 kg), which had already lost 20.63% of the original harvest mass (63.00±3.74 kg) due to moisture loss and physical handling during the 8-hour gap between harvesting and processing. Consequently, the overall conversion from fresh harvest to green bean is a more conventional 49.21%. This finding reveals a significant pre-processing economic leakage in the supply chain. It underscores that while CM creates substantial value from the raw material it receives, maximising overall farmer income depends not only on premium fermentation but also on optimising post-harvest logistics to minimise losses before processing.

The distribution of this created value is both equitable and sustainable. A significant portion, 70.45±11.36% (labour share, N), is distributed as wages, highlighting the labour-intensive nature of CM and its positive impact on rural employment and household income (Mammo et al. 2021). This finding contrasts with literature highlighting value chain inequalities but is explained by the collective ownership model of the farmer groups, which facilitates equitable upstream value distribution (Neilson et al. 2018; Quiñones-Ruiz et al. 2020).

Despite operating under the same PMPIG association, labour share distribution showed considerable variation (SD=±11.36%), ranging from 51% to 89% across farmers. This suggests that while collective action provides a foundation for equitable distribution, implementation varies significantly at the individual level. The consistently high average labour share (70.45%), however, confirms that the collective model successfully maintains a generally pro-labour distribution overall.

Theoretical implications

This study provides a novel theoretical contribution by integrating EVA and Hayami methods to measure the impact of post-harvest innovation quantitatively. This integrated framework offers a sharper analytical lens for understanding the mechanisms of value creation and distribution at the farm level, moving beyond conventional profitability analysis to capture true economic value.

Practical implications

The findings offer actionable insights for key stakeholders:

For Farmers and Cooperatives: CM represents a proven, high-return investment that significantly enhances household income and economic resilience. The technology generates an average annual economic value added of IDR 5.95 million per hectare, demonstrating strong financial viability. Farmers should prioritise both CM adoption and pre-processing logistics optimisation to minimise the observed 20.63% mass loss during transport.

For Policy Makers and Development Agencies: Results justify targeted interventions including: (i) technical training programs for CM quality control and consistent implementation; (ii) facilitated access to financing for CM equipment through People's Business Credit (KUR) schemes; (iii) institutional strengthening of farmer groups to ensure equitable benefit distribution, addressing the observed variability in labour share (51-89%); and (iv) strategic market promotion of Ijen-Raung CM coffee to sustain premium pricing and market differentiation.

For Supply Chain Managers: The significant pre-processing mass loss (20.63%) highlights the critical need for improved post-harvest logistics, including better transportation infrastructure, moisture-retention packaging, and reduced time gaps between harvesting and processing to maximise overall value capture.

In conclusion, this study demonstrates that Carbonic Maceration (CM) can enhance the economic value of Geographical Indication of Ijen-Raung Arabica coffee by improving conversion efficiency, reducing mass loss, and generating positive value addition based on the Hayami method. The integrated EVA and Hayami analysis confirm that the CM process generates substantial positive Economic Value Added of IDR 5,946,424.74 per hectare annually, proving that the enterprise delivers returns exceeding the cost of all capital employed. The Hayami method further reveals an efficient value-creation process with a high value-added ratio of 45.13% and a generally equitable distribution, with 70.45% of value added allocated to labour income.

A critical finding is the 20.63% mass loss occurring during the 8-hour post-harvest window, which reduces the overall conversion efficiency from fresh harvest to green bean from 62.00% to 49.21%. These results show that CM is a viable value-creation innovation for smallholder farmers and can strengthen the market competitiveness of the Ijen-Raung Geographical Indication. However, the study is limited by the relatively small sample size, the focus on short-term production cycles, and the absence of sensory cupping scores and market-price variability analyses that could more fully contextualise CM's economic performance. In addition, financial risks, labour constraints, and differences in farmer processing capacity were not examined in detail.

The primary practical recommendation stemming from this evidence is the systematic promotion and support for CM technology adoption among Ijen-Raung coffee farmers, complemented by interventions to improve post-harvest logistics. This dual approach will fully actualise the premium price potential inherent in the Geographical Indication certification, thereby directly enhancing farer welfare and livelihood resilience in the Bondowoso coffee sector. The future research should incorporate multi-season datasets, integrate sensory quality and speciality market premiums, and evaluate the financial feasibility of CM under different price scenarios. Expanding the analysis to include risk assessment, farmer capacity-building needs, and long-term profitability models will strengthen policy recommendations and support broader adoption of carbonic maceration within the GI region.

REFERENCES

Barjolle D, Quiñones-Ruiz XF, Bagal M, Comoé H. 2017. The role of the state for geographical indications of coffee: Case studies from Colombia and Kenya. World Dev 98: 105-119. https://doi.org/10.1016/j.worlddev.2016.12.006.

Belletti G, Marescotti A, Touzard JM. 2017. Geographical indications, public goods, and sustainable development: The roles of actors' strategies and public policies. World Dev 98: 45-57. https://doi.org/10.1016/j.worlddev.2015.05.004.

Bowen S. 2010. Embedding local places in global spaces: Geographical indications as a territorial development strategy. Rural Sociol 75 (2): 209-243. https://doi.org/10.1111/j.1549-0831.2009.00007.x.

Cinner JE, Barnes ML. 2019. Social dimensions of resilience in social-ecological systems. One Earth 1 (1): 51-56. https://doi.org/10.1016/j.oneear.2019.08.003.

Cucagna ME, Goldsmith PD. 2018. Value adding in the agri-food value chain. Intl Food Agribus Manag Rev 21 (3): 293-316. https://doi.org/10.22434/ifamr2017.0051.

Da Silva MCS, Veloso TGR, Junior DB, Bullergahn VB, da Luz JMR, Menezes KMS, Guarçoni RC, Kasuya MCM, Pereira LL. 2023. Bacterial community and sensory quality from coffee are affected during fermentation under carbonic maceration. Food Chem Adv 3: 100554. https://doi.org/10.1016/j.focha.2023.100554.

Darnhofer I. 2014. Resilience and why it matters for farm management. Eur Rev Agric Econ 41 (3): 461-484. https://doi.org/10.1093/erae/jbu012.

Folke C. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. Glob Environ Chang 16 (3): 253-267. https://doi.org/10.1016/j.gloenvcha.2006.04.002.

Government of Indonesia. 2021. Undang-Undang Republik Indonesia Nomor 7 Tahun 2021 tentang Harmonisasi Peraturan Perpajakan [Law of the Republic of Indonesia Number 7 of 2021 Concerning Harmonization of Tax Regulations]. Lembaran Negara Republik Indonesia Tahun 2021 Nomor 20. State Secretariat, Jakarta. [Indonesian]

Halil H, Afriliana A, Setiadevi S, Wicaksono DW, Yustita AD. 2024. Production process and value-added of robusta coffee leaf essential oils. AIP Conf Proc. 3098: 040011. https://doi.org/10.1063/5.0223815.

Hayami Y, Kawagoe T, Morooka Y, Siregar M. 1987. Agricultural Marketing and Processing in Upland Java: A Perspective from a Sunda Village. CGPRT Center, Bogor.

Herminingsih H, Rokhani R, Iswati I, Sudarko S. 2023. Manfaat ekonomi sertifikasi Indikasi Geografis (IG) terhadap petani kopi rakyat: Studi kasus di Kabupaten Bondowoso, Jawa Timur. Jurnal Ilmu Respati 14 (1): 1-15. https://doi.org/10.52643/jir.v14i1.3082. [Indonesian]

Junior DB, Guarçoni RC, da Silva MCS, Veloso TGR, Kasuya MCM, Oliveira ECS, da Luz JMR, Moreira TR, Debona DG, Pereira LL. 2021. Microbial fermentation affects the sensorial, chemical, and microbial profile of coffee under carbonic maceration. Food Chem 342: 128296. https://doi.org/10.1016/j.foodchem.2020.128296.

Kilian B, Jones C, Pratt L, Villalobos A. 2006. Is sustainable agriculture a viable strategy to improve farm income in Central America? A case study on coffee. J Bus Res 59 (3): 322-330. https://doi.org/10.1016/j.jbusres.2005.09.015.

Kyriazis D, Anastassis C. 2007. The validity of the economic value added approach: An empirical application. Eur Financ Manag 13 (1): 71-100. https://doi.org/10.1111/j.1468-036x.2006.00286.x.

Lestari F, Maryadi M, Adriani D. 2021. Analisis nilai tambah aneka olahan bubuk kopi robusta berbasis industri rumah tangga (Kecamatan Pagaralam Utara, Kota Pagaralam). Jurnal Paradigma Agribisnis 3 (2): 56-70. https://doi.org/10.33603/jpa.v3i2.4951. [Indonesian]

Li C, Ban Q, Ge L, Qi L, Fan C. 2024. The relationship between geographical indication products and farmers' incomes based on meta-analysis. Agriculture 14 (6): 798. https://doi.org/10.3390/agriculture14060798.

Mammo N, Asfaw M, Abera N. 2021. Impact of agricultural cooperatives on income of households: The case of Ejere District, Oromia National Regional State, Ethiopia. Eur J Bus Manag 13 (9): 25-34. https://doi.org/10.7176/ejbm/13-9-03.

Neilson J, Wright J, Aklimawati L. 2018. Geographical indications and value capture in the Indonesia coffee sector. J Rural Stud 59: 35-48. https://doi.org/10.1016/j.jrurstud.2018.01.003.

Neilson J. 2007. Institutions, the governance of quality, and on-farm value retention for Indonesian specialty coffee. Singap J Trop Geogr 28 (2): 188-204. https://doi.org/10.1111/j.1467-9493.2007.00290.x.

Poetschki K, Peerlings J, Dries L. 2021. The impact of geographical indications on farm incomes in the EU olive and wine sector. Br Food J 123 (13): 579-598. https://doi.org/10.1108/bfj-12-2020-1119.

Quiñones-Ruiz XF, Nigmann T, Schreiber C, Neilson J. 2020. Collective action milieus and governance structures of protected geographical indications for coffee in Colombia, Thailand, and Indonesia. Intl J Commons 15 (1): 329-343. https://doi.org/10.5334/ijc.1007.

Taufiqurrahman, Fajri, Hakim L. 2020. The value-added analysis of Gayo Arabica coffee based on processing. Intl J Multicult Multirelig Underst 7 (1): 33-41. https://dx.doi.org/10.18415/ijmmu.v7i1.1281.

Teuber R. 2010. Geographical indications of origin as a tool of product differentiation: The case of coffee. J Intl Food Agribus Mark 22 (3): 277-298. https://doi.org/10.1080/08974431003641612.

Török Á, Jantyik L, Maró ZM, Moir HVJ. 2020. Understanding the real-world impact of geographical indications: A critical review of the empirical economic literature. Sustainability 12 (22): 9434. https://doi.org/10.3390/su12229434.

Várady M, Tauchen J, Fraňková A, Klouček P, Popelka P. 2022. Effect of method of processing specialty coffee beans (natural, washed, honey, fermentation, maceration) on bioactive and volatile compounds. LWT 172: 114245. https://doi.org/10.1016/j.lwt.2022.114245.

Wibowo Y, Palupi CB. 2022. Analisis nilai tambah pengolahan biji kopi arabika (Studi kasus: Rumah Kopi Banjarsengon, Jember). Jurnal Agroteknologi 16 (1): 37-48. https://doi.org/10.19184/j-agt.v16i1.28209. [Indonesian]

Wibowo Y, Purnomo BH, Kristio A. 2021. The agroindustry development strategy for Java Ijen-Raung Arabica coffee, in Bondowoso Regency, East Java. Industria Jurnal Teknologi dan Manajemen Agroindustri 10 (2):134-145. https://doi.org/10.21776/ub.industria.2021.010.02.5. [Indonesian]

Yin X, Li J, Wu J, Cao R, Xin S, Liu J. 2024. Impacts of geographical indications on agricultural growth and farmers' income in rural China. Agriculture 14 (1): 113. https://doi.org/10.3390/agriculture14010113.