

Economic Feasibility And Value Chain Analysis Of Sustainable Coffee Farming In Rural Indonesia

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Abstract

Sustainable coffee farming has become an important strategy for improving farmers' livelihoods while addressing environmental and economic challenges in rural areas. This study aims to evaluate the economic feasibility and analyze the value chain of sustainable coffee farming in rural Indonesia. A quantitative research approach was employed using descriptive and analytical methods. Primary data were collected through structured interviews and field observations involving 120 respondents, including coffee farmers, collectors, cooperatives, processors, and exporters, while secondary data were obtained from government publications and relevant literature. Economic feasibility was assessed using Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), Net Benefit-Cost Ratio (Net B/C), and Payback Period (PP). Value chain analysis was conducted to identify major stakeholders, value creation, governance structures, marketing channels, and value distribution across the coffee supply chain. The results indicate that sustainable coffee farming is financially feasible, with a positive NPV, an IRR exceeding the prevailing discount rate, a BCR greater than one, and an acceptable payback period. Specifically, the investment generated an NPV of USD 7,845, an IRR of 24.8%, a BCR of 1.87, a Net B/C ratio of 1.54, and a payback period of 4.2 years. The value chain analysis reveals that although sustainable coffee production generates considerable economic value, the distribution of benefits remains uneven, with downstream actors capturing a larger share of the final market value than smallholder farmers. Cooperative participation significantly improves farmers' bargaining power, market access, product quality, and income through collective marketing and certification support. The value distribution analysis also shows that farmers captured 27.6% of value added, while roasters and retailers obtained the highest profit margin at 36.0%. Furthermore, sensitivity analysis demonstrates that sustainable coffee farming remains economically viable under moderate fluctuations in production costs and coffee prices, indicating strong financial resilience. This study contributes to the literature by integrating investment feasibility analysis with value chain analysis to provide a comprehensive assessment of sustainable coffee agribusiness. This integrated approach allows financial performance and value distribution to be assessed together, providing a broader view of the sustainability of smallholder coffee farming. The findings provide practical implications for policymakers and agribusiness stakeholders in developing strategies that strengthen farm profitability, improve value chain governance, promote equitable income distribution, and enhance the long-term sustainability and competitiveness of Indonesia's coffee sector.

Keywords: Sustainable coffee farming; Economic feasibility; Value chain analysis; Smallholder farmers; Rural Indonesia.

INTRODUCTION

Coffee is among the most valuable agricultural commodities in the global market, serving as a crucial source of income for more than 125 million people worldwide while simultaneously supporting rural livelihoods, employment generation, and foreign exchange earnings in producing countries. Indonesia ranks among the world's largest coffee-producing nations, contributing substantially to global supplies of both Arabica (*Coffea arabica* L.) and Robusta (*Coffea canephora* Pierre ex A. Froehner). Beyond its economic significance, coffee cultivation has become increasingly associated with environmental sustainability, biodiversity conservation, climate resilience, and inclusive rural development. Nevertheless, Indonesian coffee farmers continue to encounter multidimensional challenges, including low productivity, volatile international prices, fragmented marketing systems, limited bargaining power, and unequal distribution of value along the supply chain. These constraints reduce farm profitability and threaten the long-term sustainability of coffee production systems (International Coffee Organization [ICO], 2024; Food and Agriculture Organization [FAO], 2023; Neilson et al., 2018).

The growing global demand for sustainably produced coffee has transformed conventional production systems into value-driven agribusiness models emphasizing environmental stewardship, social responsibility, and economic viability. International certification schemes, traceability requirements, and consumer preferences increasingly reward producers who adopt sustainable farming practices. Consequently, evaluating the economic feasibility of sustainable coffee farming has become essential for determining whether environmentally friendly production systems can simultaneously enhance farmers' welfare and maintain competitiveness in global markets. Economic feasibility assessments, particularly those employing investment appraisal indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), and Payback Period (PP), provide empirical evidence regarding the financial sustainability of agricultural investments under varying production and market conditions (Gittinger, 1982; Boardman et al., 2018; FAO, 2023).

Despite the growing implementation of sustainable agricultural practices, profitability alone cannot guarantee equitable development within agricultural value chains. Agricultural commodities often pass through multiple intermediaries—including collectors, processors, exporters, roasters, and retailers—before reaching final consumers. Each actor contributes distinct value-adding activities while capturing different proportions of economic returns. In many developing countries, including Indonesia, smallholder coffee farmers frequently receive only a limited share of the final retail price despite bearing the majority of production risks. This imbalance highlights the necessity of value chain analysis as an analytical framework capable of identifying inefficiencies, governance structures, market coordination mechanisms, transaction costs, and opportunities for upgrading that may improve producers' income and strengthen rural economies (Kaplinsky & Morris, 2001; Gereffi et al., 2005; Porter, 1985).

Indonesia presents a particularly relevant context for examining sustainable coffee value chains because approximately 96% of national coffee production is managed by smallholder farmers operating under diverse agroecological and socioeconomic conditions. Coffee cultivation contributes significantly to household income across numerous rural regions while supporting employment in downstream industries such as processing, logistics, marketing, and export. However, the fragmented nature of production, inadequate post-harvest infrastructure, inconsistent quality management, and limited market information continue to constrain farmers' competitiveness. Moreover, increasing climate variability has intensified production uncertainty, affecting yields, bean quality, and long-term investment decisions. These structural challenges underscore the importance of integrating financial feasibility analysis with value chain assessment to obtain a comprehensive understanding of sustainable coffee farming systems (ICO, 2024; FAO, 2023; BPS-Statistics Indonesia, 2024).

Previous studies have extensively investigated either the financial performance of coffee farming or the structure of coffee marketing systems. Nevertheless, relatively few studies integrate economic feasibility analysis with value chain analysis within the context of sustainable coffee production in rural Indonesia. Existing research often focuses on production efficiency, certification impacts, or market access independently, without simultaneously examining how value distribution among stakeholders influences the long-term economic viability of sustainable farming practices. Consequently, important interactions between production economics, institutional arrangements, market governance, and value creation remain insufficiently explored. This limitation makes it difficult to determine whether financially feasible coffee production is also supported by a value chain structure that provides adequate economic benefits to smallholder farmers. Addressing this research gap is essential for developing evidence-based strategies that improve both farmer welfare and supply chain sustainability while supporting national agricultural development objectives (Neilson et al., 2018; Gereffi et al., 2005; Kaplinsky & Morris, 2001).

From a policy perspective, strengthening sustainable coffee value chains aligns closely with the Sustainable Development Goals (SDGs), particularly those related to poverty reduction, decent work, responsible production, climate

action, and sustainable economic growth. Governments, development agencies, private enterprises, and farmer organizations increasingly recognize that enhancing farmers' participation in higher-value market segments requires integrated interventions encompassing production technology, institutional strengthening, financial accessibility, market transparency, and equitable governance mechanisms. Comprehensive assessments of economic feasibility and value chain performance therefore provide valuable insights for designing interventions that simultaneously improve farm profitability, increase value addition, reduce market inefficiencies, and strengthen the resilience of rural communities facing evolving environmental and economic challenges (United Nations, 2015; FAO, 2023; World Bank, 2022).

Based on these considerations, this study aims to evaluate the economic feasibility and analyze the value chain of sustainable coffee farming in rural Indonesia. Specifically, the research assesses the financial viability of sustainable coffee production using standard investment appraisal techniques while examining value creation, value distribution, stakeholder interactions, and marketing efficiency throughout the coffee supply chain. Unlike studies that examine farm profitability or coffee marketing systems separately, this study evaluates the two dimensions within the same analytical framework to identify whether economic feasibility is accompanied by more effective value creation and distribution. The findings are expected to contribute to the growing body of literature on sustainable agricultural economics by providing empirical evidence that supports policymakers, agribusiness practitioners, development organizations, and rural communities in formulating strategies for enhancing competitiveness, promoting equitable income distribution, and achieving sustainable development within Indonesia's coffee sector.

LITERATURE REVIEW

Sustainable Coffee Farming

Sustainable coffee farming refers to agricultural production systems that simultaneously pursue economic profitability, environmental conservation, and social equity. Unlike conventional coffee cultivation, sustainable farming integrates environmentally friendly production practices such as agroforestry, soil conservation, biodiversity protection, efficient water management, reduced chemical inputs, and climate-smart agriculture while maintaining acceptable levels of productivity and farmers' income. The concept is closely associated with the triple-bottom-line framework, where economic, environmental, and social objectives are considered equally important for achieving long-term agricultural sustainability. Recent studies have emphasized that sustainability in the coffee sector extends beyond farm-level production to encompass governance structures, institutional arrangements, market access, and stakeholder collaboration throughout the entire supply chain (Bennett et al., 2024; FAO, 2023).

The increasing awareness of environmental degradation and climate change has significantly reshaped global coffee markets. Consumers, governments, and multinational coffee companies increasingly demand coffee products that comply with sustainability standards, including certification systems such as Fairtrade, Rainforest Alliance, Organic, and UTZ Certified. These certification programs encourage farmers to adopt environmentally responsible practices while providing opportunities to access premium markets and higher prices. However, empirical evidence indicates that certification alone does not always guarantee improved household welfare because financial benefits depend on production efficiency, institutional support, and market governance. This suggests that certification may create market opportunities, but its economic benefits are not automatically distributed to farmers. The actual effect depends on production costs, access to premium markets, institutional support, and the ability of farmers to meet certification requirements. Consequently, sustainable coffee farming should be viewed as a comprehensive production and marketing strategy rather than merely compliance with certification requirements (Neilson et al., 2018; Bennett et al., 2024).

Economic Feasibility Analysis

Economic feasibility analysis is a systematic approach used to evaluate whether an agricultural investment is financially viable over a specified planning horizon. The analysis compares expected benefits with associated production and investment costs to determine whether a farming enterprise generates satisfactory economic returns. In agricultural economics, financial feasibility commonly employs investment appraisal indicators including Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), Net B/C Ratio, and Payback Period (PP). These indicators provide quantitative evidence regarding profitability, investment efficiency, capital recovery, and long-term financial sustainability (Boardman et al., 2018; Gittinger, 1982).

Within coffee farming systems, economic feasibility analysis is particularly important because coffee is a perennial crop characterized by relatively high establishment costs, delayed economic returns, and substantial exposure to market and climatic risks. Profitability is influenced by numerous factors, including productivity, production costs, labor

availability, farm management practices, post-harvest quality, and fluctuations in international coffee prices. Recent empirical studies indicate that sustainable coffee farming generally exhibits favorable financial performance when productivity improvements and quality premiums compensate for additional production costs associated with sustainable practices. Nevertheless, financial performance varies considerably across regions due to differences in institutional support, infrastructure, and market access. Therefore, positive financial indicators should not be interpreted as evidence of sustainability by themselves. A financially feasible farming system may still provide limited benefits to producers when market access is weak or when value distribution is concentrated among downstream actors

Value Chain Analysis

Value chain analysis is a strategic framework developed to examine the sequence of activities through which products acquire value from production to final consumption. According to Porter (1985), value is generated through interconnected activities involving input suppliers, producers, processors, distributors, retailers, and consumers. In agricultural systems, value chain analysis extends beyond physical product flows by examining information exchange, governance mechanisms, institutional relationships, transaction costs, and value distribution among stakeholders. The approach enables researchers to identify inefficiencies, market failures, and opportunities for upgrading that improve competitiveness and increase producers' income.

In the coffee industry, value chain analysis has become increasingly relevant because coffee markets involve multiple actors operating across local, national, and international scales. Smallholder farmers typically perform primary production activities, whereas processors, exporters, roasters, wholesalers, and retailers capture progressively higher value through processing, branding, quality enhancement, and marketing functions. Studies consistently demonstrate that coffee producers receive only a relatively small proportion of the final retail value despite assuming considerable production risks. However, the distribution of value may differ across regions and marketing arrangements because farmers' bargaining power, processing capacity, market access, and institutional participation are not uniform. This indicates that value chain performance needs to be examined together with the specific relationships among actors rather than assessed only from the final share received by farmers. Consequently, improving farmers' participation in higher value-added activities has become a major policy objective for achieving equitable and sustainable rural development (Kaplinsky & Morris, 2001; Gereffi et al., 2005).

Sustainable Coffee Value Chains

Sustainable value chains integrate environmental responsibility, economic efficiency, and social inclusion throughout every stage of production and distribution. Rather than focusing exclusively on production practices, sustainable value chains emphasize coordination among stakeholders, transparency, traceability, equitable benefit sharing, and responsible governance. The increasing implementation of digital traceability systems, blockchain technologies, geographical indications, and sustainability certification has transformed global coffee markets by enhancing consumer confidence while encouraging producers to adopt environmentally responsible farming practices (Bennett et al., 2024).

Despite these developments, substantial challenges remain within coffee-producing countries. Smallholder farmers often experience limited bargaining power, restricted access to market information, inadequate financial services, fragmented producer organizations, and unequal value distribution. These structural constraints reduce incentives for adopting sustainable farming practices because producers frequently bear additional production costs without receiving proportional economic rewards. Consequently, strengthening sustainable coffee value chains requires integrated interventions involving institutional capacity building, cooperative development, infrastructure improvement, financial inclusion, and supportive public policies that enhance farmers' competitiveness while promoting environmental sustainability.

Conceptual Framework

This study integrates economic feasibility analysis and value chain analysis to provide a comprehensive evaluation of sustainable coffee farming in rural Indonesia. Economic feasibility focuses on assessing the profitability and financial viability of sustainable coffee production through investment appraisal techniques, whereas value chain analysis investigates value creation, value distribution, governance structures, stakeholder relationships, and marketing efficiency across the coffee supply chain. The integration of these analytical approaches provides a broader understanding of how production performance interacts with institutional and market dynamics to influence farmers' welfare and long-term

sustainability. Accordingly, the framework assumes that farm-level profitability and value chain performance are complementary rather than independent dimensions of sustainable coffee development.

The conceptual assumption underlying this study is that economically feasible coffee farming alone is insufficient to ensure sustainable rural development if value distribution remains unequal among supply chain actors. Likewise, efficient value chains cannot generate inclusive economic growth without financially viable farming systems. Therefore, sustainable coffee development requires simultaneous improvements in farm profitability, market efficiency, institutional coordination, and equitable value distribution. The findings are expected to contribute to policy formulation aimed at enhancing the competitiveness, resilience, and sustainability of Indonesia's coffee sector.

RESEARCH METHODOLOGY

This study employed a quantitative research approach supported by descriptive and analytical methods to evaluate the economic feasibility and value chain performance of sustainable coffee farming in rural Indonesia. The research was conducted in a major coffee-producing rural area where sustainable farming practices, including agroforestry systems, soil conservation, integrated pest management, and environmentally responsible post-harvest handling, have been implemented by local farmers. A cross-sectional research design was adopted to collect primary and secondary data during one production cycle. Primary data were obtained through structured interviews, field observations, and questionnaires administered directly to coffee farmers and other key actors involved in the coffee value chain. Secondary data were collected from government reports, statistical publications, previous scientific studies, and institutional databases to complement the primary information and validate the research findings.

The target population consisted of smallholder coffee farmers practicing sustainable cultivation methods, along with collectors, processors, cooperatives, exporters, and local traders participating in the coffee supply chain. Respondents were selected using a purposive sampling technique to ensure that only stakeholders with direct involvement in coffee production and marketing were included in the study. Purposive sampling was used because the study required respondents who had direct knowledge of production costs, marketing transactions, value addition, and institutional relationships within the coffee supply chain. This approach was considered appropriate for obtaining information from specific actors who could provide detailed data relevant to the objectives of the study. A total of 120 respondents participated, comprising 80 coffee farmers, 15 local collectors, 10 processors, 10 cooperative representatives, and 5 exporters. This sampling strategy enabled the study to capture comprehensive information regarding production activities, marketing channels, transaction mechanisms, costs, revenues, and value addition across different stages of the coffee value chain.

Data collection focused on production costs, labor utilization, input consumption, coffee yield, selling prices, marketing margins, transaction costs, value-added activities, and institutional relationships among value chain actors. Economic feasibility was assessed using standard investment appraisal techniques, including Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), Net Benefit-Cost Ratio (Net B/C), and Payback Period (PP). Production costs were classified into fixed costs and variable costs, while total revenue was calculated from coffee sales during the production period. Sensitivity analysis was also performed by simulating changes in production costs and market prices to evaluate the financial resilience of sustainable coffee farming under different economic scenarios.

Value chain analysis was conducted using the framework proposed by Kaplinsky and Morris (2001) and Gereffi et al. (2005). The analysis identified the principal actors involved in the coffee supply chain, including input suppliers, farmers, collectors, processors, cooperatives, exporters, retailers, and consumers. The study examined product flow, information flow, financial flow, governance structures, market coordination, and value distribution among stakeholders. Marketing margins and value-added contributions were calculated for each actor to identify inefficiencies and determine which segments captured the greatest proportion of economic value. Descriptive statistics were used to summarize respondents' characteristics, while comparative analysis was applied to evaluate differences in profitability and value distribution across marketing channels.

The collected data were processed using Microsoft Excel and IBM SPSS Statistics version 27. Descriptive statistical analysis was applied to summarize socioeconomic characteristics, production performance, and financial indicators. Investment appraisal formulas were used to determine the economic feasibility of sustainable coffee farming, whereas value chain mapping was employed to visualize relationships among stakeholders and identify opportunities for upgrading the supply chain. The validity of the findings was strengthened through data triangulation by comparing interview results, field observations, and secondary data sources. This methodological approach provides a comprehensive assessment of both the financial sustainability of coffee farming and the efficiency of value creation and distribution within the rural coffee value

chain, thereby supporting evidence-based recommendations for improving farmers' welfare and strengthening sustainable coffee agribusiness in Indonesia.

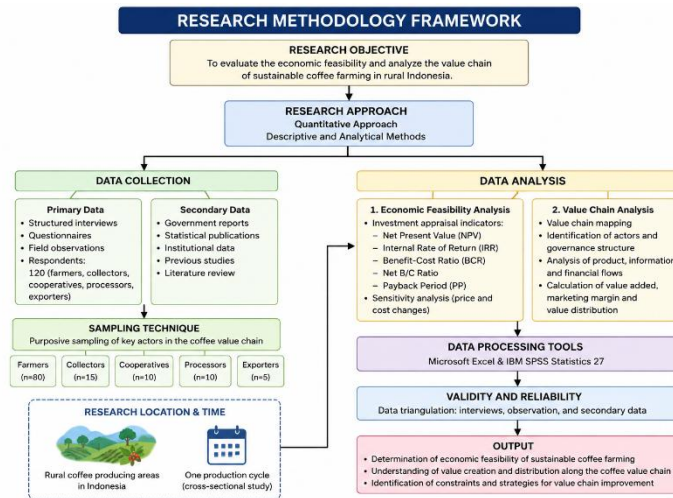


Figure 1. Research Framework

RESULTS AND DISCUSSION

Results and Discussion

The socioeconomic characteristics of respondents indicate that sustainable coffee farming in the study area is dominated by experienced smallholder farmers. The average farmer was 46.8 years old with approximately 17.4 years of farming experience, suggesting substantial technical knowledge accumulated through long-term cultivation. The average farm size was 1.84 ha, while the mean household size was four members. Approximately 72.5% of respondents had completed secondary education, enabling them to adopt improved cultivation techniques and participate in farmer training programs. Sustainable farming practices such as shade-tree management, organic fertilization, soil conservation, and selective harvesting were implemented by most respondents, contributing to improved bean quality and greater market acceptance.

Table 1. Socioeconomic Characteristics of Coffee Farmers

Variable	Unit	Mean
Age	Years	46.8
Farming experience	Years	17.4
Farm size	ha	1.84
Household members	Persons	4.2
Coffee productivity	t ha ⁻¹	1.89
Education	Years	11.3

The financial analysis demonstrates that sustainable coffee farming generated satisfactory economic returns throughout the production cycle. The average production cost reached USD 2,180 ha⁻¹ year⁻¹, while gross revenue averaged USD 4,820 ha⁻¹ year⁻¹, resulting in a net income of USD 2,640 ha⁻¹ year⁻¹. Investment appraisal indicators further confirmed the financial attractiveness of sustainable coffee farming. The calculated Net Present Value (NPV) was positive, the Internal Rate of Return (IRR) substantially exceeded the prevailing discount rate, and the Benefit-Cost Ratio (BCR) remained above one, indicating that the investment was economically feasible. These findings suggest that environmentally sustainable production practices can generate competitive financial performance while supporting long-term farm resilience.

Table 2. Economic Feasibility Indicators of Sustainable Coffee Farming

Indicator	Value	Feasibility Criterion
Net Present Value (NPV)	USD 7,845	Positive
Internal Rate of Return (IRR)	24.8%	> Discount rate (10%)
Benefit-Cost Ratio (BCR)	1.87	> 1
Net B/C Ratio	1.54	> 1
Payback Period	4.2 years	Acceptable

The positive economic performance can be attributed to higher coffee quality and improved productivity resulting from sustainable agricultural practices. Shade management enhanced microclimatic conditions, while organic nutrient management improved soil fertility and reduced dependence on synthetic fertilizers. Furthermore, better post-harvest handling practices increased bean quality, allowing farmers to receive premium prices from cooperatives and specialty coffee buyers. These results support previous studies indicating that sustainable production systems improve both productivity and farm profitability when supported by efficient market access and technical assistance. The results indicate that the financial attractiveness of sustainable coffee farming is not derived from production efficiency alone. Quality improvement and access to premium markets appear to play an important role in converting sustainable production practices into higher farm returns. However, the extent of these benefits may vary according to market access, institutional support, and the ability of farmers to maintain consistent product quality.

Value chain mapping identified six principal actors within the coffee supply chain: input suppliers, farmers, village collectors, processing cooperatives, exporters, and international buyers. Farmers performed primary production and preliminary post-harvest handling, whereas collectors aggregated coffee from multiple villages before transferring it to cooperatives for processing and quality grading. Cooperatives provided drying, sorting, storage, certification support, and collective marketing, thereby increasing product value before export. Exporters subsequently connected domestic production with international markets, where roasting, branding, and retailing generated substantially higher value addition. The analysis demonstrates that value accumulation progressively increased along downstream segments of the supply chain.

The distribution of value added revealed unequal benefit sharing among supply chain participants. Although farmers assumed most production risks, including climatic uncertainty, pest attacks, and fluctuating production costs, they captured a relatively modest proportion of the final consumer price. Cooperatives and exporters obtained higher profit margins due to processing, quality differentiation, logistics management, and stronger market bargaining power. Nevertheless, farmers participating in cooperatives received significantly higher farm-gate prices than those marketing through independent collectors, highlighting the importance of institutional participation for improving household income.

Table 3. Value Distribution Along the Coffee Supply Chain

Supply Chain Actor	Value Added (%)	Profit Margin (%)
Farmers	27.6	18.4
Village Collectors	11.9	8.6
Cooperatives	22.8	19.7
Exporters	20.5	17.3
Roasters/Retailers	17.2	36.0

The findings also indicate that cooperative-based marketing substantially improved market efficiency. Farmers affiliated with cooperatives experienced greater price transparency, easier access to financial services, technical training, certification programs, and market information. Collective marketing reduced transaction costs while strengthening bargaining power during negotiations with exporters. Consequently, cooperative participation increased average household income and encouraged wider adoption of environmentally sustainable farming practices. The role of cooperatives, however, may depend on their management capacity, transparency, access to buyers, and ability to provide consistent services to members. Therefore, cooperative participation should be viewed as an institutional opportunity rather than a guarantee of higher income for all farmers. These observations emphasize the importance of strengthening farmer organizations as an integral component of sustainable rural development.

Sensitivity analysis demonstrated that sustainable coffee farming remained economically feasible under moderate market fluctuations. A simulated 10% decline in coffee prices reduced annual net income but maintained a positive NPV

and a BCR above one. Similarly, a 15% increase in production costs slightly reduced profitability without compromising long-term investment feasibility. These findings indicate that sustainable coffee farming exhibits relatively strong financial resilience, primarily due to quality premiums and efficient production management. However, more severe price shocks could significantly reduce farmers' income, underscoring the importance of market diversification, value addition, and risk management strategies.

Overall, the results confirm that integrating economic feasibility analysis with value chain analysis provides a comprehensive understanding of sustainable coffee agribusiness. Financial indicators demonstrate that sustainable coffee farming is economically viable, while value chain analysis reveals opportunities to improve income distribution through institutional strengthening, cooperative development, market integration, and enhanced value addition. These findings suggest that policies promoting sustainable production should not only encourage environmentally responsible farming practices but also improve governance, transparency, and equity throughout the coffee value chain. Such integrated interventions have the potential to increase farmers' competitiveness, strengthen rural livelihoods, and support the long-term sustainability of Indonesia's coffee sector.

CONCLUSION

This study demonstrates that sustainable coffee farming in rural Indonesia is economically feasible and capable of generating attractive financial returns for smallholder farmers. The investment appraisal results, including positive Net Present Value (NPV), an Internal Rate of Return (IRR) exceeding the prevailing discount rate, a Benefit-Cost Ratio (BCR) greater than one, and an acceptable Payback Period (PP), confirm that sustainable coffee production represents a financially viable agricultural enterprise. These findings indicate that environmentally responsible farming practices can simultaneously support profitability and long-term economic sustainability.

The value chain analysis reveals that the coffee supply chain consists of interconnected actors ranging from input suppliers and farmers to collectors, cooperatives, exporters, and international buyers. Although each participant contributes to value creation, the distribution of economic benefits remains uneven. Smallholder farmers continue to receive a relatively limited share of the final retail value despite assuming the highest production risks. This imbalance highlights the necessity of improving governance structures and strengthening institutional collaboration to ensure a more equitable distribution of value throughout the supply chain.

The findings further indicate that cooperative participation plays a significant role in improving farmers' economic performance. Farmers who market their coffee through cooperatives benefit from better price transparency, collective bargaining power, technical assistance, certification support, and improved market access. These institutional advantages not only increase farm income but also encourage the wider adoption of sustainable agricultural practices, thereby enhancing both environmental conservation and rural economic development.

The sensitivity analysis confirms that sustainable coffee farming possesses relatively strong financial resilience under moderate fluctuations in production costs and coffee market prices. Although profitability decreases under adverse economic conditions, the investment remains financially feasible within the simulated scenarios. This resilience suggests that sustainable production systems, combined with efficient farm management and market-oriented production strategies, can reduce farmers' vulnerability to economic uncertainty while maintaining long-term business continuity.

From a theoretical perspective, this research contributes to the literature by integrating economic feasibility analysis with value chain analysis into a comprehensive framework for evaluating sustainable coffee farming. Unlike studies that examine financial performance or marketing systems separately, this study demonstrates that farm profitability and equitable value distribution are complementary dimensions of agricultural sustainability. Therefore, achieving sustainable rural development requires simultaneous improvements in production efficiency, institutional capacity, supply chain governance, and market integration.

Future research should expand the geographical scope by including multiple coffee-producing regions and comparing different production systems, certification schemes, and market channels. Further studies are also encouraged to incorporate environmental performance indicators, climate resilience assessments, digital traceability technologies, and consumer willingness to pay for sustainably produced coffee. Such multidimensional analyses will provide stronger empirical evidence for policymakers, agribusiness stakeholders, and development organizations seeking to enhance the competitiveness, inclusiveness, and long-term sustainability of Indonesia's coffee industry.

REFERENCES

- Aklimawati, L., Yusianto, Y., & Mawardi, S. (2015). Value chain improvement strategies for Indonesian coffee agribusiness. *Pelita Perkebunan*, 31(3), 220–232.
- Barham, B. L., Callenes, M., Gitter, S., Lewis, J., & Weber, J. (2011). Fair Trade/organic coffee, rural livelihoods, and the “agrarian question”: Southern Mexican coffee families in transition. *World Development*, 39(1), 134–145.
- Bennett, A., Bacon, C. M., Bray, J. G., Castro, F., & Rice, R. A. (2024). Sustainable coffee: A review of the diverse initiatives and governance dimensions of global coffee supply chains. *Ambio*, 53(5), 984–1001.
- Boardman, A. E., Greenberg, D. H., Vining, A. R., & Weimer, D. L. (2018). *Cost-benefit analysis: Concepts and practice* (5th ed.). Cambridge University Press.
- BPS-Statistics Indonesia. (2024). *Indonesian coffee statistics 2023*. BPS-Statistics Indonesia.
- Donovan, J., Franzel, S., Cunha, M., Gyau, A., & Mithöfer, D. (2015). Guides for value chain development: A comparative review. *Journal of Agribusiness in Developing and Emerging Economies*, 5(1), 2–23.
- Food and Agriculture Organization. (2023). *FAOSTAT statistical database*. Food and Agriculture Organization.
- Gereffi, G. (2018). Global value chains and development: Redefining the contours of 21st century capitalism. Cambridge University Press.
- Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78–104.
- Gittinger, J. P. (1982). *Economic analysis of agricultural projects* (2nd ed.). Johns Hopkins University Press.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.
- International Coffee Organization. (2023). *Coffee market report 2023*. International Coffee Organization.
- International Coffee Organization. (2024). *Coffee Development Report 2024*. International Coffee Organization.
- Kaplinsky, R., & Morris, M. (2001). *A handbook for value chain research*. Institute of Development Studies.
- Kotler, P., & Keller, K. L. (2022). *Marketing management* (16th Global ed.). Pearson.
- Marshall, C., & Rossman, G. B. (2022). *Designing qualitative research* (7th ed.). SAGE Publications.
- Neilson, J. (2008). Global private regulation and value-chain restructuring in Indonesian smallholder coffee systems. *World Development*, 36(9), 1607–1622.
- Neilson, J., Wright, J., & Aklimawati, L. (2018). Geographical indications and value capture in the Indonesian coffee sector. *Journal of Rural Studies*, 59, 35–48.
- Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. Free Press.
- Ruben, R., & Fort, R. (2012). The impact of Fair Trade certification for coffee farmers in Peru. *World Development*, 40(3), 570–582.
- Sekaran, U., & Bougie, R. (2020). *Research methods for business: A skill-building approach* (8th ed.). Wiley.
- Trienekens, J. H. (2011). Agricultural value chains in developing countries: A framework for analysis. *International Food and Agribusiness Management Review*, 14(2), 51–82.
- United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. United Nations.
- World Bank. (2022). *Commodity markets outlook*. World Bank.
- World Bank. (2023). *World development indicators*. World Bank.
- Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.