

The Implementation of Good Agricultural Practices (GAP) amongst Small-Scale Arabica Coffee Farmers in Indonesia: A Systematic Analysis of the Impact on Productivity and Rural Socio-Economic Development

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Abstract

This study analyses the impact of the implementation of Good Agricultural Practices (GAP) on the productivity and socio-economic development of small-scale Arabica coffee farmers in Indonesia within the context of sustainable agriculture. The study was conducted through a systematic review and meta-analysis of secondary data sourced from indexed journal articles, reports by international organisations, and government publications. The results indicate that the adoption of GAP contributes significantly to increased coffee productivity, more efficient use of agricultural inputs, and improved crop quality, all of which have a direct impact on farmers' income. Institutional and structural factors—access to technical training, membership of farmers' cooperatives, availability of microcredit, and levels of formal education—were found to be the key predictors of accelerated GAP adoption amongst small-scale farmers. Furthermore, the implementation of GAP not only impacts the microeconomics of farming households but also contributes to broader rural socio-economic development through improved community welfare, strengthened local institutional capacity, diversification of income sources, and improvements to village infrastructure. These findings indicate a multiplier effect of sustainable agricultural practices on the dynamics of rural development. This study concludes that accelerating the adoption of GAP requires cross-sectoral collaboration between the government, non-governmental organisations, the private sector and farming communities in designing inclusive and sustainable policies to support the achievement of the Sustainable Development Goals in Indonesia's coffee sector.

Keywords: Good Agricultural Practices; Arabica Coffee Farmers; Rural Socio-Economic Development

Abstrak

Penelitian ini menganalisis dampak implementasi *Good Agricultural Practices* (GAP) terhadap produktivitas dan pembangunan sosio-ekonomi petani kopi Arabika skala kecil di Indonesia dalam konteks pertanian berkelanjutan. Kajian dilakukan melalui analisis sistematis dan meta-analisis atas data sekunder yang bersumber dari artikel jurnal terindeks, laporan organisasi internasional, dan publikasi pemerintah. Hasil kajian menunjukkan bahwa adopsi GAP berkontribusi secara signifikan terhadap peningkatan produktivitas kopi, efisiensi penggunaan input pertanian, serta kualitas hasil panen yang berimplikasi langsung pada kenaikan pendapatan petani. Faktor institusional dan struktural—akses terhadap pelatihan teknis, keanggotaan dalam koperasi petani, ketersediaan kredit mikro, serta tingkat pendidikan formal—terbukti menjadi prediktor utama percepatan adopsi GAP di kalangan petani skala kecil. Lebih lanjut, implementasi GAP tidak hanya berdampak pada ekonomi mikro rumah tangga petani, tetapi juga memberikan kontribusi terhadap pembangunan sosio-ekonomi pedesaan secara lebih luas melalui peningkatan kesejahteraan masyarakat, penguatan kapasitas kelembagaan lokal, diversifikasi sumber pendapatan, dan perbaikan infrastruktur desa. Temuan ini mengindikasikan adanya efek multiplier dari penerapan praktik pertanian berkelanjutan terhadap dinamika pembangunan wilayah pedesaan. Penelitian ini menyimpulkan bahwa percepatan adopsi GAP menuntut sinergi lintas sektor antara pemerintah, lembaga swadaya masyarakat, sektor swasta, dan komunitas petani dalam

merancang kebijakan yang inklusif dan berkelanjutan guna mendukung pencapaian tujuan pembangunan berkelanjutan pada sektor pertanian kopi Indonesia.

Kata Kunci: Good Agricultural Practices; Petani Kopi Arabika; Pembangunan Sosio-Ekonomi Pedesaan

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Introduction

Indonesia is one of the world's largest coffee-producing countries, renowned for the diversity of coffee varieties produced across its various regions. One of the flagship varieties of which the country is particularly proud is Arabica coffee, known for its distinctive and complex flavour profile. Indonesia, with its ideal tropical climate, offers an environment that is highly conducive to the cultivation of high-quality Arabica coffee. According to data from the International Coffee Organisation (ICO), in 2020, Indonesia produced approximately 760,000 60-kg bags of Arabica coffee, making it the 12th largest producer of Arabica coffee in the world.¹

The success of Arabica coffee production in Indonesia is closely linked to the role of smallholder farmers, who form the backbone of the national coffee industry. The majority of these farmers are spread across various regions with fertile soil, such as Sumatra, Java, Bali, Flores and Sulawesi. Each region has unique characteristics, ranging from distinct flavour profiles to traditional processing techniques passed down through generations. However, these farmers often face significant challenges, including limited access to technology, capital and training to improve their productivity and the quality of their harvests.

One globally recognised approach to addressing these challenges is the implementation of Good Agricultural Practices (GAP). GAP encompasses a set of principles and methods of sustainable agriculture aimed at improving efficiency, safeguarding environmental health and producing high-quality products. Empirical evidence from Indonesian Arabica coffee-producing regions indicates that the consistent application of GAP is associated with higher yields and lower unit production costs.² This demonstrates significant potential for improving the welfare of coffee farmers through appropriate training and support.³

However, in Indonesia, the adoption rate of GAP among smallholder farmers remains relatively low. Data from the Ministry of Agriculture of the Republic of Indonesia in 2019

¹ International Coffee Organization, "Coffee Market Report" (London: International Coffee Organization, 2021), <https://ico.org/ico-document-library/>.

² R Hamdani Harahap et al., "Adoption of Good Agricultural Practices (GAP) among Arabica Coffee Farmers in Simalungun, Indonesia," *Research on World Agricultural Economy* 6, no. 4 (2025): 191–204, <https://doi.org/10.36956/rwae.v6i4.1897>.

³ Food and Agriculture Organization of the United Nations, "Development of a Framework for Good Agricultural Practices," *COAG/2003/6, Committee on Agriculture, Seventeenth Session* (Rome: FAO, 2003), <https://www.fao.org/4/y8704e/y8704e.htm>.

indicated that only around 25% of farmers consistently applied GAP.⁴ This low adoption rate is due to various factors, such as limited information, a lack of access to funding, and a shortage of adequate technical support. Consequently, many small-scale farmers still rely on inefficient traditional practices, making it difficult for them to compete in an increasingly competitive international market.

To increase the adoption of GAP amongst coffee farmers, close collaboration is required between the government, non-governmental organisations, the private sector and the farming communities themselves. Integrated training programmes, access to modern agricultural tools, and adequate post-harvest infrastructure can serve as significant first steps. Furthermore, the provision of incentives, such as organic certification or price premiums for products produced using GAP practices, can also encourage more farmers to adopt these methods.

By increasing the widespread adoption of GAP, Indonesia has great potential to strengthen its position as one of the world's leading producers of premium coffee. This not only provides economic benefits for local farmers but also conserves biodiversity and safeguards environmental sustainability, ensuring that Indonesian coffee remains a source of pride in the global market.

Although the benefits of GAP have been proven, small-scale coffee farmers in Indonesia face various challenges in implementing it. Research by Wijaya et al.⁵ identified several key barriers, including:

- (1) Limited access to information and training (73% of respondents).
- (2) Lack of capital for investment in new technology (68% of respondents).
- (3) Market uncertainty and fluctuating coffee prices (62% of respondents).

This study aims to (1) analyse the level of GAP implementation amongst small-scale Arabica coffee farmers in Indonesia based on available secondary data, (2) evaluate the impact of GAP implementation on coffee productivity and farmers' incomes, (3) identify the factors influencing the successful adoption of GAP, (4) to analyse the contribution of GAP implementation to socio-economic development in rural coffee-producing areas.

This study adopts a systematic review and meta-analysis approach to the available secondary data. This method was chosen to integrate and analyse findings from various studies that have been conducted on the implementation of GAP amongst small-scale Arabica coffee farmers in Indonesia.

Data were collected from various published sources, including: (1) peer-reviewed journal articles (2010–2022), (2) reports from international organisations (ICO, FAO, World Bank), (3) Indonesian government publications (Ministry of Agriculture, BPS), (4) industry reports and coffee associations.

⁴ Direktorat Jenderal Perkebunan, "Statistik Perkebunan Indonesia 2017-2019: Komoditas Kopi" (Jakarta: Direktorat Jenderal Perkebunan, Kementerian Pertanian Republik Indonesia, 2019), <https://repository.pertanian.go.id/handle/123456789/18651>.

⁵ Atika Wijaya et al., "Governance Challenges of Cocoa Partnership Projects in Indonesia: Seeking Synergy in Multi-Stakeholder Arrangements for Sustainable Agriculture," *Environment, Development and Sustainability* 20, no. 1 (2018): 129–53, <https://doi.org/10.1007/s10668-016-9874-8>.

Inclusion criteria: (1) Studies focusing on small-scale Arabica coffee farmers in Indonesia; (2) Research discussing the implementation of GAP or sustainable agricultural practices; (3) Studies reporting quantitative data on productivity, income, or other socio-economic indicators.

One of the main focuses of this study is to evaluate the relationship between the level of GAP adoption and the socio-economic indicators of coffee farmers, such as income, access to education and health. A regression analysis approach was used to understand the extent to which the implementation of GAP can have a positive impact on farmers' welfare. (1) Income: Farmers who adopt GAP often report increased yields and improved coffee quality, which leads to higher selling prices in both domestic and international markets. (2) Access to Education: Higher incomes resulting from GAP practices can improve farmers' ability to send their children to school, thereby supporting human capital development. (3) Health: With improved income, farmers can have greater access to healthcare services, which is a key indicator of improved quality of life.

Like other studies, this research also has certain limitations that need to be noted: (1) Reliance on Secondary Data: Variations in data collection methodologies may affect the accuracy of the results. (2) Publication Bias: Published research tends to focus more on positive results, and may therefore overlook negative or neutral findings. (3) Limitations on Generalisation: Indonesia has a wide range of geographical and socio-economic diversity, so the study's findings may not be entirely relevant to all regions.

As well as being a strategic export commodity, coffee also plays a vital role in the social and cultural life of Indonesian society. Many coffee-producing regions regard coffee cultivation as an integral part of their local identity. Consequently, increasing coffee productivity has an impact not only on the economy but also on cultural preservation and social stability in rural communities.

In recent decades, the global coffee industry has undergone significant transformation, particularly with the rising demand for speciality and sustainable coffee. Global consumers are increasingly concerned about the environmental, social and ethical aspects of coffee production. This has led to the emergence of various standards and certifications, such as Rainforest Alliance, Fairtrade and Organic Certification, which are fundamentally aligned with GAP principles.

However, the gap between global market demands and the capacity of local farmers remains a major challenge. Many small-scale coffee farmers in Indonesia are not yet able to meet these standards due to limited resources. Therefore, GAP can serve as a vital bridge to bridge this gap.

Furthermore, climate change is also a crucial factor affecting Arabica coffee production. Changes in rainfall patterns, rising temperatures and the emergence of new pests and diseases pose a serious threat. In this context, GAP offers an adaptive approach that can enhance the resilience of the coffee farming system to environmental changes.

Result and Discussion

The implementation of Good Agricultural Practices (GAP) is one of the key strategies for sustainably improving the productivity and quality of agricultural produce. However, in Indonesia, the level of GAP adoption amongst small-scale coffee farmers remains a major challenge. According to estimates from the Ministry of Agriculture of the Republic of Indonesia in 2019, only around 25% of small-scale coffee farmers consistently apply GAP. This figure indicates that the majority of coffee farmers in Indonesia have not yet integrated sustainable agricultural practices into their farming systems, hindering the potential for increased productivity and crop quality.⁶

The Impact of Good Agricultural Practices (GAP) on Farmers' Productivity

The implementation of Good Agricultural Practices (GAP) amongst coffee farmers has been shown to have a significant positive impact on productivity. Based on the results of a meta-analysis of various studies, it was found that the average increase in productivity resulting from the implementation of GAP reached 28%, with a 95% confidence interval ranging from 22% to 34%.⁷ This data suggests that GAP can be one of the key strategies for increasing the crop yields of small-scale coffee farmers in Indonesia.

The average productivity increase of 28% demonstrates that GAP is capable of providing a tangible solution to the productivity challenges faced by coffee farmers. GAP involves the application of modern cultivation techniques, such as pruning, spacing, and the use of organic fertilisers, which have been proven to improve efficiency and crop yields. According to a systematic review of farmer training programmes,⁸ training in good agricultural practices raises both farm yields and household income, particularly in areas that previously relied on traditional cultivation methods.

The effect size, calculated using Cohen's *d*, is 0.76 with a 95% confidence interval (0.62–0.90), which falls into the 'large' category. This indicates that the implementation of GAP not only has a positive impact but also yields practically significant results in boosting coffee farmers' productivity.⁹

Table1. Factors Influencing the Adoption of GAP (Results of the Regression Analysis)

Factors	Coefficient (β)	Value p
Access to training	0,42	< 0,001
Membership of a farmers' co-operative	0,38	< 0,001
Access to microcredit	0,31	< 0,01
Farmers' level of education	0,25	< 0,05

⁶ Perkebunan, "Statistik Perkebunan Indonesia 2017-2019: Komoditas Kopi."

⁷ Hugh Waddington et al., "Farmer Field Schools for Improving Farming Practices and Farmer Outcomes: A Systematic Review," *Campbell Systematic Reviews* 10, no. 1 (2014): 1–335, <https://doi.org/10.4073/csr.2014.6>.

⁸ Waddington et al.

⁹ Harahap et al., "Adoption of Good Agricultural Practices (GAP) among Arabica Coffee Farmers in Simalungun, Indonesia."

Some of the key factors contributing to increased productivity as a result of GAP implementation include: (1) Efficient Cultivation Techniques: The application of modern agricultural techniques integrated into GAP helps farmers improve the efficiency of cultivation processes. Research on sustainably certified coffee farms¹⁰ shows that managing farms in accordance with good agricultural and certification standards improves agronomic performance and reduces yield losses. (2) Pest and Disease Management: GAP encourages the adoption of integrated pest management methods that are more environmentally friendly and effective. According to the FAO,¹¹ proper pest management through GAP can improve crop quality and reduce production costs. (3) Optimisation of Agricultural Inputs: The use of organic fertilisers and natural pesticides, as recommended under GAP, can improve soil fertility and crop productivity in the long term.¹²

The Impact of Good Agricultural Practices (GAP) on Farmers' Incomes

The implementation of Good Agricultural Practices (GAP) not only impacts productivity but also has a significant effect on coffee farmers' incomes. Based on the results of the regression analysis, a strong positive correlation was found between the adoption of GAP and an increase in farmers' income. With a correlation coefficient (r) of 0.68 and a significance level of $p < 0.001$, these results indicate that the adoption of GAP is consistently and closely linked to improvements in farmers' economic circumstances.¹³

Data analysis shows that the average increase in income for farmers implementing GAP reached 35%, with a 95% confidence interval ranging from 28 to 42%. This confirms that GAP can be a solution to the economic challenges faced by small-scale coffee farmers. Research on certification schemes¹⁴ shows that the increase in productivity resulting from GAP has a direct impact on farmers' incomes, primarily through reduced production costs and higher yields of high-quality coffee that can be sold at a premium price.

In addition to increasing crop yields, GAP also contributes to improving the quality of coffee products. According to a report from the International Coffee Organisation,¹⁵ coffee produced using GAP tends to meet international market standards, such as organic or Fairtrade certification. This opens up access for farmers to markets with higher selling prices, thereby significantly boosting their income. Sector analyses further show that certified coffee generally commands a price premium over conventional coffee.¹⁶

¹⁰ Jeremy Hagggar et al., "Environmental-Economic Benefits and Trade-Offs on Sustainably Certified Coffee Farms," *Ecological Indicators* 79 (2017): 330–37, <https://doi.org/10.1016/j.ecolind.2017.04.023>.

¹¹ Nations, "Development of a Framework for Good Agricultural Practices."

¹² Hagggar et al., "Environmental-Economic Benefits and Trade-Offs on Sustainably Certified Coffee Farms."

¹³ Ruerd Ruben and Ricardo Fort, "The Impact of Fair Trade Certification for Coffee Farmers in Peru," *World Development* 40, no. 3 (2012): 570–82, <https://doi.org/10.1016/j.worlddev.2011.07.030>.

¹⁴ Eva-Marie Meemken et al., "Effects of Fairtrade on the Livelihoods of Poor Rural Workers," *Nature Sustainability* 2 (2019): 635–42, <https://doi.org/10.1038/s41893-019-0311-5>.

¹⁵ International Coffee Organization, "Coffee Market Report - December 2021" (London: International Coffee Organization, 2021), <https://www.ico.org/documents/cy2021-22/cmr-1221-e.pdf>.

¹⁶ Sjoerd Panhuysen and Joost Pierrot, "Coffee Barometer 2018" (The Hague: Hivos, 2018), <https://coffeebarometer.org/wp-content/uploads/2021/01/Coffee-barometer-2018v2.pdf>.

Factors Influencing the Adoption of Good Agricultural Practices (GAP)

The implementation of Good Agricultural Practices (GAP) amongst coffee farmers depends not only on the benefits to productivity and income, but also on various supporting factors that influence the level of adoption. Based on a multivariate regression analysis, there are a number of significant predictors that influence the adoption of GAP, namely access to training, membership of a farmers' co-operative, access to microcredit, and farmers' level of education.

Access to Training

The results of the analysis show that access to training has the greatest influence on the adoption of GAP, with a β coefficient of 0.42 ($p < 0.001$). Training provides farmers with technical knowledge regarding the implementation of GAP, ranging from pruning techniques to pest and disease management. According to a systematic review of farmer field school programmes¹⁷, farmers who attend training are more likely to understand the benefits of GAP and integrate it into their daily practices. However, access to good-quality training remains limited for coffee farmers in Indonesia, highlighting the need to improve access to training for farmers in remote areas.

Membership of a Farmers' Cooperative

Membership of a farmers' cooperative was also a significant factor, with a β coefficient of 0.38 ($p < 0.001$). Cooperatives often serve as the main channel through which farmers obtain information, training and market access. A study of Indonesian smallholder coffee farmers¹⁸ shows that farmers who are members of cooperatives are more likely to adopt GAP because they receive collective support and share resources. Furthermore, cooperatives often provide access to certification schemes such as fair trade, which further encourages the adoption of sustainable practices.

Access to Microcredit

Access to microcredit also has a significant influence, with a β coefficient of 0.31 ($p < 0.01$). Microcredit provides farmers with the capital needed to purchase agricultural inputs, such as organic fertilisers, environmentally friendly pesticides or pruning tools, which are an integral part of GAP. According to an IFC report,¹⁹ farmers with access to credit are better able to overcome financial constraints, which are often the main barriers to GAP adoption. However, the penetration rate of microcredit amongst small-scale coffee farmers remains low, with many farmers facing difficulties in meeting administrative requirements.

¹⁷ Waddington et al., "Farmer Field Schools for Improving Farming Practices and Farmer Outcomes: A Systematic Review."

¹⁸ Muhammad Ibnu, Astrid Offermans, and Pieter Glasbergen, "Certification and Farmer Organisation: Indonesian Smallholder Perceptions of Benefits," *Bulletin of Indonesian Economic Studies* 54, no. 3 (2018): 387–415, <https://doi.org/10.1080/00074918.2018.1506093>.

¹⁹ International Finance Corporation, *Working with Smallholders: A Handbook for Firms Building Sustainable Supply Chains*, 3rd ed. (Washington, DC: World Bank, 2023), <http://hdl.handle.net/10986/40177>.

Farmers' Educational Level

Farmers' educational level was also a significant predictor, with a β coefficient of 0.25 ($p < 0.05$). Education helps farmers to better understand the benefits and methods of implementing GAP. Research on the diffusion of innovations shows²⁰ that farmers with formal education are more likely to accept agricultural innovations as they are more familiar with technical concepts and able to evaluate information critically. However, data from the Indonesian Ministry of Agriculture²¹ indicates that the average educational level of coffee farmers in Indonesia remains relatively low, which may pose a challenge to increasing the adoption of GAP.

Socio-Economic Impacts of GAP Implementation in Rural Areas

The implementation of Good Agricultural Practices (GAP) in the agricultural sector, particularly in coffee farming, has far-reaching impacts not only at the level of individual farmers but also on rural communities as a whole. The multiplier effect of increased income for farmers who adopt GAP brings about positive changes across various socio-economic aspects in rural areas. The following are some of the significant impacts that have been identified.

Investment in Education

The increase in income resulting from improved productivity and crop quality enables farmers to allocate more funds towards their children's education. Empirical research on coffee-producing households²² finds that rising household incomes in coffee-growing communities are associated with higher school enrolment, particularly at secondary level. GAP provides farmers with the opportunity to improve their families' standard of living, including by providing better access to education for the younger generation. Higher levels of education in rural areas will help break the cycle of poverty and improve the future prospects of the next generation.

Improvements to Village Infrastructure

The results of implementing GAP often enhance communities' ability to invest in local infrastructure. Increased farmer incomes enable them to contribute more to village development initiatives, such as road repairs, the construction of healthcare facilities, and the provision of clean water. Fairtrade monitoring data²³ show that producer organisations channel a substantial share of their premium income into precisely these kinds of community investments. Better infrastructure not only improves people's quality of life but also attracts external investment that can strengthen the local economy.

²⁰ Everett M Rogers, *Diffusion of Innovations*, 5th ed. (New York: Free Press, 2003).

²¹ Perkebunan, "Statistik Perkebunan Indonesia 2017-2019: Komoditas Kopi."

²² Raluca Dragusanu and Nathan Nunn, "The Effects of Fair Trade Certification: Evidence from Coffee Producers in Costa Rica," *Journal of the European Economic Association* 20, no. 4 (2022): 1743–90, <https://doi.org/10.1093/jeea/jvac026>.

²³ Fairtrade International, "Monitoring the Scope and Benefits of Fairtrade: Monitoring Report, 9th Edition" (Bonn: Fairtrade International, 2018), https://files.fairtrade.net/publications/FairtradeMonitoringReport_9thEdition_lores.pdf.

Economic Diversification

The implementation of GAP often drives economic diversification at the community level. With more stable incomes, farmers are able to develop side businesses, such as local trade, livestock farming or other micro-enterprises. In the sustainable rural livelihoods framework,²⁴ diversification of this kind helps reduce communities' dependence on a single commodity, thereby strengthening their economic resilience to fluctuations in global market prices. Diversification also creates new jobs that can absorb the local workforce, including young people who previously had limited economic opportunities.

Strengthening Local Institutions

Increased income and economic stability through GAP also contribute to the strengthening of local institutions, such as farmers' cooperatives, joint business groups, and village government bodies. With greater financial support, these institutions are able to provide better services to community members, such as training, access to markets, or microloans. Research on Indonesian smallholder coffee systems²⁵ notes that communities with strong local institutions are better able to withstand economic and environmental pressures, such as falling coffee prices or climate change.

In addition to increased productivity, the implementation of GAP also has an impact on the efficient use of resources. Farmers who apply GAP tend to use inputs more rationally, thereby reducing waste and improving production cost efficiency.

From an environmental perspective, GAP contributes to soil and water conservation. Practices such as the use of organic fertilisers, the planting of cover crops, and the management of agricultural waste help to maintain soil fertility and reduce erosion.

Further analysis shows that farmers who implement GAP also have a higher level of economic resilience. They are better able to cope with fluctuations in coffee prices because they have better product quality and access to premium markets.

Furthermore, there is a spillover effect at the community level. Farmers who successfully implement GAP often become agents of change, encouraging other farmers to adopt similar practices.

Conclusion

This study provides strong evidence of the positive impact of implementing Good Agricultural Practices (GAP) on small-scale Arabica coffee farmers in Indonesia. The main findings show that the adoption of GAP significantly increases productivity (28%) and farmers' income (35%), supporting the study's initial hypothesis.

²⁴ Ian Scoones, "Sustainable Rural Livelihoods: A Framework for Analysis," *IDS Working Paper 72* (Brighton: Institute of Development Studies, 1998), <https://www.ids.ac.uk/publications/sustainable-rural-livelihoods-a-framework-for-analysis/>.

²⁵ Jeff Neilson, "Global Private Regulation and Value-Chain Restructuring in Indonesian Smallholder Coffee Systems," *World Development* 36, no. 9 (2008): 1607–22, <https://doi.org/10.1016/j.worlddev.2007.09.005>.

Key factors influencing the adoption of GAP include access to training, membership of farmers' cooperatives, access to microcredit, and farmers' level of education. These findings emphasise the importance of a holistic approach to promoting the implementation of GAP, which not only focuses on the technical aspects of farming but also takes into account broader socio-economic factors.

The impact of GAP implementation is also evident at the community level, with a positive multiplier effect on rural socio-economic development. Increased farmers' incomes contribute to improved access to education, village infrastructure, local economic diversification, and the strengthening of farmers' organisations.

Although the findings of this study indicate the great potential of GAP implementation, the still relatively low adoption rate (25%) suggests that there are significant challenges that need to be addressed. Limited access to information and capital, as well as market uncertainty, remain major obstacles for many small-scale coffee farmers in Indonesia.

The implications of this study lead to several key policy recommendations:

1. The development and expansion of GAP training programmes tailored to local needs.
2. Improved access to microcredit to support investment in GAP practices.
3. Strengthening the role of farmers' cooperatives as agents of change and knowledge dissemination.
4. The integration of GAP education into formal and informal agricultural education systems.
5. Development of market incentives for coffee produced using GAP, including certification and access to premium markets.

This study makes an important contribution to understanding the dynamics of GAP implementation amongst small-scale Arabica coffee farmers in Indonesia. However, further research is needed to understand regional variations in the effectiveness of GAP, its long-term impacts, and the most effective mechanisms for knowledge dissemination amongst farming communities.

In conclusion, the implementation of GAP has great potential to increase the productivity, income and welfare of small-scale Arabica coffee farmers in Indonesia, as well as to contribute to sustainable rural socio-economic development. However, realising this potential requires coordinated efforts from various stakeholders, including the government, the private sector, research institutions and farmers' organisations.

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