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From Harvesting Practices to Market Orientation: Empowering Coffee Farmers through Participatory On-Farm Cupping Tests

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Abstract: This community service program aims to describe the implementation of on-farm coffee cupping across different harvesting methods and to analyze its effects on farmers' technical practices, quality awareness, and market orientation. The program was implemented using a Participatory Action Research (PAR) approach based on six stages adapted from Saliyo's framework and delivered through an Andragogy-Based Coffee School involving 18 coffee farmers (14 men and 4 women) in collaboration with a local coffee farmers' group in Wonosalam Village. Data were collected through participatory observation, on-farm cupping using the Specialty Coffee Association (SCA) sensory evaluation protocol, and focus group discussions. Quantitative descriptive analysis was employed to visualize cup profiles using radar charts, while qualitative thematic analysis was used to examine participants' experiences and behavioral changes. The results revealed a clear relationship between harvesting methods and coffee flavor profiles. Strip picking produced flat sensory characteristics with relatively low cup quality, whereas selective picking combined with mossto fermentation generated more complex flavor profiles characterized by fruity and wine-like attributes. The program increased farmers' awareness of coffee quality, encouraged the adoption of selective harvesting and post-harvest sorting practices, and expanded market opportunities from conventional local markets to specialty and export-oriented markets. These findings suggest that participatory, experience-based learning through on-farm cupping can promote quality-oriented production practices and enhance the competitiveness of smallholder coffee farmers.

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Introduction

Coffee is one of the flagship commodities of the plantation subsector, making a significant contribution to Indonesia's economy. National coffee production in 2022 was recorded at 794,762 metric tons and is projected to reach 789,609 metric tons in 2023, with export volume totaling 437,560 metric tons in 2022, generating foreign exchange earnings of USD 1.15 billion (Supriyati, 2023). This trend continues, with the value of Indonesia's coffee

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exports in 2024 increasing by 76.33% compared to 2023, reaching over USD 1.6 billion, with the United States, Egypt, and Malaysia as the primary destination countries. National coffee production is generally projected to continue increasing in line with the expansion of cultivated land and high global demand, while the value of exports also shows an upward trend influenced by world coffee prices and exchange rate fluctuations (Nugroho et al., 2025). Wonosalam, Jombang Regency, is known as one of the leading centers for producing the best coffee in East Java, particularly the Excelsa variety, which is ranked as the second-best coffee in the province (Anam et al., 2024). As a member of the liberoid group distinct from the arabicoid and robustoid groups, Excelsa coffee possesses a unique phenotype characterized by larger leaves as well as a distinctive flavor profile with high acidity reminiscent of tropical fruits, berries, guava, and apples, often accompanied by winey or spicy notes.

Although it has great potential as a specialty coffee, Excelsa coffee harvesting practices in Wonosalam still vary widely and reflect differences in farmers' knowledge levels and production approaches. Some farmers use the strip-pick method, picking all the cherries regardless of ripeness, resulting in a harvest that includes a mix of ripe red, yellow, green, and overripe cherries all in the pursuit of time and quantity efficiency, but at the cost of inconsistent bean quality. Other farmers practice selective picking (selective pick), harvesting only fully ripe red cherries (red cherry), which yields better bean quality despite requiring more time and labor. This situation is exacerbated by farmers' continued focus on production quantity at the expense of quality, resulting in suboptimal Excelsa coffee production in Wonosalam, particularly in terms of marketing (Amalia et al., 2023).

A number of previous studies have confirmed that harvesting methods are a key determinant of coffee quality: cherries picked when fully ripe (red) produce higher-quality beans compared to those harvested through non-selective picking (Wiradinata et al., 2021). To objectively measure this quality, the Specialty Coffee Association (SCA) has established a cupping test standard requiring a minimum score of 80 out of 100 across the following aspects: fragrance, flavor, aftertaste, acidity, body, balance, uniformity, clean cup, sweetness, and overall quality (da Mota et al., 2020), with the results visualized as a cup profile in the form of a radar chart. The literature also indicates that cupping tests not only serve as a quality evaluation tool but also have the potential to be an effective educational tool for farmers. Through the experience of directly tasting the coffee from their own farms, farmers can understand the relationship between cultivation practices (Good Agricultural Practice) and post-harvest practices (Good Manufacturing Practice) and the resulting flavor profile, including detecting flavor defects caused by errors in fermentation or drying (Sunarharum et al., 2018). Unlike laboratory cupping, which requires standardized room conditions, on-farm cupping is more flexible and focused on understanding rather than official scores, making it a relevant learning tool for farmers (Ferasta et al., 2023). This relevance is reinforced by the andragogical framework proposed by Knowles, 1984 which emphasizes that adult learning including that of farmers is more effective when it is based on direct experience), oriented toward solving real-world problems and addresses the need to understand the practical benefits of the material being studied (Lubis, 2020).

However, these studies generally discuss cupping tests solely as a standalone instrument for sensory quality evaluation, separate from data on the diversity of harvesting practices in the field, and have not yet extensively explored the application of on-farm cupping integrated with an andragogical approach as a learning strategy for Excelsa coffee farmers. In fact, farmers' understanding of coffee's sensory quality is a key factor in the transformation from a commodity crop to specialty coffee (Setyowati et al., 2021). Therefore,

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integrating technical evaluation with a participatory educational approach is crucial for fostering sustainable behavioral change among farmers. Based on this gap, this community service offers a scientific innovation in the form of integrating data on the diversity of harvesting methods with the results of sensory evaluation or cupping, as well as the application of on-farm cupping as an andragogical learning method for Excelsa coffee farmers in Wonosalam, an approach that has not been extensively studied in previous literature.

In light of these gaps and new developments, this community service focuses on two issues: (1) the relationship between the implementation of cupping tests and the diversity of harvesting methods and flavor profiles of Wonosalam Excelsa coffee has not been systematically documented; and (2) the impact of on-farm cupping activities on farmers' technical practices, quality awareness, and branding strategies has not been extensively analyzed within an andragogical learning framework. Therefore, this community service program aims to describe the implementation of cupping tests on farmers' plots, taking into account variations in harvesting methods, and to analyze their impact on farmers' technical practices, quality awareness, and market orientation

Method

This employs a Participatory Action Research (PAR) approach, which actively involves farmers as subjects in both the research and learning processes. PAR is a social research model widely used in community service activities because it directly links the research process with the process of social change (Diaz & Polanco, 2026). The choice of this method is based on the need to bring about tangible change among research participants through a process of problem identification, followed by actions designed to address those problems, so that the benefits of the research can be directly felt by the community both through the results and through their participatory experience throughout the process. In this approach, the researcher acts as a facilitator who provides perspectives and input, rather than as the sole controller or designer of the research process, allowing the researcher and the beneficiaries to collaborate closely at every stage of the research (Siswadi & Syaifuddin, 2024).

The application of PAR in this community service followed the six steps proposed by Njera et al., (2017), namely: (1) learning by doing, which involved discussions with the community regarding the planning, evaluation, investigation, and mapping of activities; (2) exploring the issue, which involved drawing up a schedule, setting time targets, and identifying mapping resources; (3) fact-finding and listening, which involves gathering facts, findings, and community aspirations; (4) identifying stakeholders, which involves identifying relevant parties through social analysis as well as mapping power dynamics and interconnections within the community; (5) evaluating options, which is the process of receiving input and suggestions from relevant parties; and (6) understanding the system, which involves a comprehensive understanding of the system encompassing ecological, activity, issue, option, and social domains (Thoriq et al., 2020). These six steps serve as a framework for designing a series of activities for the Andragogy-Based Coffee School, which are then implemented during the implementation phase. The choice of the PAR approach aligns with the principles of andragogy, which emphasize active participation and experience-based learning.

This community service was conducted in Wonosalam Village, Wonosalam Subdistrict, Jombang Regency, which is one of the centers of coffee production in East Java.

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The research subjects were farmers enrolled in the Coffee School, with diverse characteristics in terms of both age and gender. There was a total of 18 participants 14 men and 4 women ranging in age from 20 to 50 years who were guided by an expert mentor. In general, the participants demonstrated high enthusiasm and curiosity toward the learning process, particularly regarding cupping practices and their understanding of coffee quality and processing, although some participants tended to be passive during discussion and practical sessions, reflecting varying levels of participation in these activities. The farmers' participation in this Coffee School reflects their motivation to improve their knowledge and skills in coffee cultivation and processing, while also strengthening human resource capacity in the agricultural sector in the Wonosalam region. These activities were carried out in stages and in chronological order, following the principles of adult learning integrated with the PAR framework. The first stage involved preparation and the identification of harvesting methods, specifically direct field observations of the morphological characteristics of the harvest including variations in fruit color and leaf shape to map the harvesting methods used by individual farmers (random/row-by-row harvesting or selective harvesting). The second stage is sampling, which involves collecting coffee bean samples from each harvesting method identified in the previous stage. The third stage is post-harvest standardization, in which all samples are processed uniformly using the natural method to ensure that processed coffee from different harvesting methods can be compared fairly and under controlled conditions. The fourth stage is on-farm cupping, a tasting session conducted together with the farmers, allowing them to directly taste and evaluate the quality of the processed coffee according to the SCA sensory protocol. Data collection at this stage is qualitative, in which farmers are invited to describe their taste experiences in their own words based on what they taste and feel during the cupping session, covering aspects such as aroma, flavor, aftertaste, acidity, body, balance, and overall impression. This approach was chosen because it aligns with the principles of andragogy, which enables adult learners to understand their own sensory experiences through familiar language, rather than just unfamiliar technical terms. At the same time, the cupping process continues to follow the SCA protocol as the standard reference for coffee quality assessment; to bridge these technical standards with the farmers' level of understanding, each sensory stage employs a simplified evaluation process guided by expert facilitators/mentors so that farmers can directly and practically understand how the assessment works. In this way, cupping scores are derived from the qualitative flavor descriptions expressed by the farmers themselves, ensuring that the assessment results remain technically valid while also being meaningful and accessible to the farmers as research participants; this allows them to be not merely objects of measurement, but active participants who interpret and reflect on their own taste experiences, in line with the PAR principle that positions farmers as subjects who actively participate throughout the research process. The fifth stage is a focus group discussion, a forum that connects the cupping results and recorded flavor profiles with variations in coffee bean processing and cultivation techniques, while also serving as a space for collective reflection among the farmers. The sixth and final stage is the development of branding and market orientation strategies, namely the integration of the flavor assessment results with opportunities for product identity development and marketing strategies.

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The data were collected using three main methods, namely: (1) participatory observation of harvesting and post-harvest practices in the field; (2) cupping tests at the farm, which combined farmers' qualitative flavor descriptions with quantitative sensory scores (aroma, flavor, aftertaste, acidity, body, balance, uniformity, cup cleanliness, sweetness, and overall quality) in accordance with SCA protocols, presented in a simplified format to facilitate farmers' understanding; and (3) focus group discussions and informal interviews with farmers to explore changes in technical behavior, quality awareness, and market orientation. Sensory scoring data were analyzed using quantitative descriptive methods and presented as radar charts (cup profiles) to compare flavor characteristics across different harvesting methods, while data from observations, farmers' qualitative flavor descriptions, and focus group discussions were analyzed using qualitative descriptive methods with a thematic approach to identify patterns of change in farmers' behavior, quality awareness, and market orientation before and after participating in the Andragogy-Based Coffee School program. In this study, data collection instruments were used as part of the data collection process, as described below:

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Table 1. Data Instruments

Indicators	Harvesting Methods		
	Random/Unsorted	**Specialty**	**Premium**
Color	red, yellow, green, and overcooked	Red	Red
Classification	Mixed with defective and damaged beans and impurities	Selective - Minimal defective beans	Selective – Minimal defective beans
Sorting	No	Sorting	Sorting
Fermentation Process	No fermentation process used	Mossto	No fermentation process
Post-Harvest	Natural	Natural	Natural
Flavor Profile According to Experts	Bitter and sharp	Fruity, sweet, wine-like	berry, chocolate, even nuts
Flavor Profile According to Farmers	Has a medicinal taste that leaves a sticky aftertaste on the roof of the mouth	Fruity, aromatic, more acidic	Complex flavor, tastier than others
Price Projections	30.000 – 60.000	200.000 – 500.000	100.000 – 300.000

Result and Discussion

Variety of Harvesting Methods and Their Implications for Sensory Profiles

Excelsa coffee farmers in Wonosalam employ two distinct harvesting methods: strip picking and selective picking, each with a different production focus, the former emphasizing quantity and labor efficiency, while the latter prioritizes consistent quality (Wiradinata et al., 2021). Cupping test results show that green coffee from strip picking has a low sensory profile, characterized by a flat aroma dominated by woody and earthy notes, a herbal flavor that tends to be bland, almost undetectable acidity, a thin to watery body, and a quickly fading aftertaste (Table 2). In contrast, coffee from selective picking demonstrates a gradual improvement in quality from the premium to the specialty category when combined with must fermentation, featuring a complex floral fruity aroma and bright yet balanced acidity.

Table 2. Cupping Test Results by Harvesting and Post-Harvest Methods

Coffee Types	Fragrance/Aroma	Flavour	Acidity	Body	Aftertaste
Random/ Unsorted	Somewhat flat, with dominant woody and earthy notes, and a hint of astringency	Tends to be plain, with herbal notes; occasionally hints of boiled corn or wet earth	Low, almost nonexistent	Light to medium, sometimes watery	Fades quickly and isn't very clean
Premium (Medium Grade)	Sweet notes begin to emerge, such as light	Well-balanced, with sweetness but not yet complex; occasionally	Light, tends to be soft	Medium, rounder than the base	Longer and cleaner, with a sweet finish

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Coffee Types	Fragrance/Aroma	Flavour	Acidity	Body	Aftertaste
	caramel, nutty, and occasionally faint fruity notes	dominated by chocolate, nuts, or palm sugar			
Specialty	Complex, with distinct floral and fruity (berry, citrus, tropical) notes, and a clean finish	Very distinct, with high sweetness and bright yet balanced acidity, resulting in a lively cup	Clear and clean, depending on the variety: citrusy, malic, or tart	Medium to full, smooth texture	Long, clean, sweet, and leaves an elegant impression

Scientifically, these differences in sensory profiles can be explained by variations in the biochemical composition of coffee cherries at different stages of ripeness. In the strip-picking method, the mixing of green, red, and overripe cherries in a single harvest result in significant variations in sugar and organic acid levels among individual beans. Unripe cherries tend to have higher chlorogenic acid content and lower sugar levels, resulting in astringency and a raw, herbal character in the cup (Saifullah et al., 2022). Conversely, fully ripe fruits experience an increase in sucrose levels in the mucilage layer as they ripen; this serves as the primary substrate for microbial activity during fermentation and contributes to the formation of volatile compounds that impart a fruity aroma and sweetness to coffee produced through selective picking. The inconsistency in ripeness levels during strip picking also causes the fermentation process to proceed unevenly, with some beans under-fermented and others over-fermented, resulting in flavor defects that ultimately lower the overall cupping score. These findings are consistent with the results of a community service by Mengistu et al., 2020, which confirms that the uniformity of raw materials prior to processing is a key prerequisite for achieving consistent coffee quality and implies that the harvesting stage is the first critical point that determines the potential final quality of the coffee before it enters the post-harvest stage.

In addition to biochemical factors, the cupping test also had an impact on the farmers' perspectives. From the outset, the facilitators emphasized the importance of the farmers' honesty in evaluating flavor based on their daily consumption experiences, which encouraged them to express their assessments naturally and confidently. Through this activity, farmers gained new insights into the specialty coffee quality standards sought by the market, which motivated them to learn about specialty processing methods. However, the cupping results do not replace the flavor preferences already ingrained in the farmers' daily lives; rather, they open up new perspectives through the lens of urban consumers' preferences.

The Effect of Post-Harvest Methods on Flavor Complexity

In addition to harvesting methods, this community service project found that post-harvest methods also play a significant role in flavor diversity, particularly through the use of must fermentation. This fermentation is defined as a fermentation technique that utilizes the liquid produced by the fermentation of the coffee bean mucilage itself, adapted from winemaking methods. Coffee processed through a combination of selective picking and mossto fermentation produces the most superior flavor profile, characterized by floral and fruity notes (berry, citrus, tropical fruit), as well as wine-like nuances not found in coffee produced using the standard natural process. Scientifically, these superior qualities can be explained by the anaerobic fermentation mechanism that occurs during the soaking of the beans in the mossto liquid: these low-oxygen conditions promote the activity of

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microorganisms (yeast and lactic acid bacteria) to metabolize the sugars in the mucilage into various ester compounds and volatile organic acids, which directly contribute to the development of fruity and wine-like nuances in the coffee (Dalimunthe et al., 2021). This process aligns with the principle of controlled fermentation, which has been widely applied to specialty-grade coffee in various producing countries, where longer durations and more prolonged anaerobic conditions correlate with increased aromatic complexity (Ferasta et al., 2023).

Figure 1. Mossto Fermentation

Figure 2. Cherry Coffee Sorting

However, the findings of this community service also reveal that the adoption of mossto fermentation among farmers in Wonosalam remains very limited, due to a lack of technical knowledge, limited processing facilities, and concerns about the risk of fermentation failure, which could reduce the market value of the coffee. This situation reinforces the argument from a community service on farmer capacity building that the transition to specialty coffee requires not only knowledge of quality standards but also ongoing technical assistance to adopt advanced processing techniques such as controlled fermentation (Setyowati et al., 2021).

The Impact of On-Farm Cupping on Quality Awareness and Changes in Technical Behavior

Before participating in on-farm cupping sessions, most farmers assumed that variations in harvesting methods did not result in significant differences in flavor. After participating in the cupping sessions, farmers were able to directly distinguish between the flat and thin character of unprocessed coffee and the more complex and cleaner flavor of coffee produced through selective picking. This shift in perception then led to tangible changes in technical practices, namely the implementation of selective picking and bean sorting prior to further processing. Theoretically, this change can be explained through (Knowles, 1984) experiential learning framework, which asserts that adult learning is most effective when participants directly experience the consequences of their actions, rather than merely passively receiving information. The experience of directly tasting the produce from one's own farm fosters stronger cognitive and affective engagement compared to conventional extension programs, so that the understanding of quality developed through cupping tends to be more deeply ingrained and drives sustainable behavioral change (Sunarharum et al., 2018). In other words, on-farm cupping functions as a sensory feedback loop that directly links farmers' actions in the field to the resulting cup of coffee consumed by customers; thus, it can be categorized as a form of experiential learning, as described by Knowles (1984).

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This behavioral change is also reflected in the fact that some farmers have begun implementing sorting practices. Sorting plays a crucial role in separating high-quality beans based on physical characteristics prior to the grading stage (Salsabila et al., 2025), and previous research has shown that proper sorting can improve coffee quality by up to 30% and reduce physical defects in beans (Mengistu et al., 2020), while also increasing market value by up to 40%, particularly in the export market segment (Rahmawati et al., 2024). The findings of this community service align with these results and reinforce the premise that quality improvement through better postharvest practices, including sorting, contributes to strengthening the competitiveness of local coffee products (Salsabila et al., 2025). However, this community service shows that the adoption of sorting in the Wonosalam case did not arise solely from technical interventions but was driven by a shift in awareness formed through direct sensory experiences during on-farm cupping, a pathway of behavioral change that has not been widely explored in previous literature on coffee sorting or postharvest practices.

Figure 3. On-Farm Cupping Test

Market Orientation and Branding Strategies

The increased awareness of quality fostered through cupping also has implications for farmers' market orientation and branding strategies. Data show a clear price segmentation among harvesting and processing methods: green coffee is priced at around Rp30,000–65,000, premium coffee at Rp100,000–300,000, while specialty coffee produced through selective picking and mossto fermentation reaches Rp200,000–500,000 (Table 3).

Table 3. The Relationship Between Harvesting Methods, Flavor Profiles, Behavioral Changes, and Market Orientation

Harvesting Methods	Visual Identity	Flavor Profile	Changes in Farmers' Technical Practices	Branding Strategy	Target Market Access
Strip Picking	Assorted fruit (red, green, overripe)	Bitter, flat, woody, earthy	Recognizing the limitations of strip picking	There is no clear branding strategy yet	Local markets
Selective Picking	Ripe fruit (red cherry)	Complex, fruity, and tart	Implementing red-picking and sorting	Emphasizing better quality	Domestic to international

This phenomenon of price premiumization can be explained through the principle of product differentiation in marketing economics, where distinctive process narratives such as "red harvest," "anaerobic fermentation," or flavor descriptors like "fruity" and "wine-like" serve to reduce information asymmetry between producers and consumers regarding quality

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attributes that are difficult to observe with the naked eye before the coffee is brewed. In this context, cupping tests serve not only as an internal quality control tool but also generate a "shared language" that enables farmers to communicate the uniqueness of their products to roasters and buyers using standardized sensory terms (Sunarharum et al., 2018). Sensory understanding is a fundamental prerequisite for the transformation of mass-market coffee into specialty coffee.

Implications for the Development of the Coffee School Learning Model

Overall, the above findings confirm that integrating data on the diversity of harvesting methods with the results of sensory evaluations through on-farm cupping can serve as an effective andragogical learning tool for Excelsa coffee farmers. The Coffee School's learning modules can be enriched with cupping practices that explicitly link variations in harvesting methods to their sensory and economic consequences, so that farmers not only gain technical knowledge but also develop descriptive sensory language skills that strengthen their bargaining position in the coffee value chain. This experiential learning approach, integrated with the PAR framework, transforms the Coffee School from merely a venue for transferring technical knowledge into a space for strengthening farmers' competitiveness through an integrated understanding of quality, branding, and market strategies.

These findings directly demonstrate that conducting on-farm cupping at the farmer level, while taking into account variations in the harvesting methods for Wonosalam Excelsa coffee, have not only successfully described the relationship between harvesting methods and flavor profiles empirically but have also had a tangible impact on changes in technical practices (adoption of selective picking and sorting), increased quality awareness, and a stronger market orientation among farmers toward the more competitive specialty coffee segment.

Conclusion

This report identifies two key findings related to the research objectives. First, the diversity of Excelsa Wonosalam coffee harvesting methods was found to have a strong correlation with the resulting flavor profile variations: the strip-picking method produces a flat sensory profile and low market value (Rp30,000–65,000), whereas selective picking—especially when combined with must fermentation—produces significantly higher flavor complexity and correlates with an increase in market value up to the premium category (Rp100,000–300,000) and even the specialty category (Rp200,000–500, 000), or an increase in value equivalent to about 7–8 times the base price. These findings confirm that harvesting methods are an early determinant of the final quality potential of Excelsa coffee as a specialty product.

Second, cupping tests on the farm proved effective as an andragogical learning method to build quality awareness among farmers. Direct sensory experiences have shifted farmers' perceptions from the initial belief that coffee flavor does not vary to an understanding that drives tangible changes in technical practices—namely, a shift from a quantity-oriented approach to a quality-oriented one through the implementation of selective harvesting and bean sorting. This is supported by previous research indicating that if coffee quality can be improved by up to 30%, market value will increase by up to 40%, particularly in the export market segment. This shift in awareness has also led to a new market orientation and branding strategy, thereby expanding market access for Wonosalam Excelsa coffee from the local segment to the domestic and international segments. Thus, the integration of sensory

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evaluation and an andragogical approach has proven to be a relevant strategy for driving sustainable improvements in both the quality and market access of Excelsa coffee.

Recommendation

Based on these findings, this community service project recommends several follow-up steps that can be classified into three main categories—academic, institutional, and market and infrastructure—to support the continued improvement of the quality and competitiveness of Wonosalam Excelsa coffee.

1) Academic Recommendations
   Further research is recommended to conduct a comprehensive chemical analysis (volatile compounds, caffeine, chlorogenic acid, and antioxidants) for each harvesting method to strengthen the objective evidence that complements the subjective sensory data from cupping. Optimization of must fermentation parameters is also necessary to develop a standardized protocol that farmers can easily replicate, accompanied by long-term economic studies to assess the feasibility of selective harvesting based on labor cost structures relative to potential income increases.
2) Institutional Recommendations
   Coffee School programs need to integrate cupping modules as a permanent part of the curriculum, supplemented by ongoing sensory training, as well as the development of a quality certification system at the farmer level as a tool to strengthen capacity and product credibility.
3) Market & Infrastructure Recommendations
   Strengthening the specialty coffee market network through partnerships with coffee roasters, coffee shops, and exporters that prioritize traceability, accompanied by direct trade schemes to optimize farmers' margins. Infrastructure support in the form of shared processing facilities, digital traceability systems, and price incentive schemes based on cupping results is needed to promote a quality-oriented approach and build the "Kopi Excelsa Wonosalam" collective brand, which highlights its geographical uniqueness and consistent quality.

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