



Guidance on Post-Harvest Management, Fermentation Technology, and Sustainable Cocoa Downstreaming to Meet Export Market Standards in Kampung Merasa, Kelay District, Berau Regency

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ABSTRACT

Cocoa (Theobroma cacao L.) in Merasa Village, Kelay District, Berau Regency, holds a critical position within East Kalimantan's plantation sector, backed by a total regional cocoa land area of 1,061.10 Ha producing 514,488.00 kg of dry beans annually. However, local farmers face extreme economic vulnerability due to a drastic 45% price collapse in non-fermented beans between January and April 2026 (falling from Rp 55,000/kg to Rp 25,000/kg), while fermented cocoa maintains a substantial price premium reaching Rp 100,000/kg. This Community Service program aims to empower cocoa farmers in Merasa Village through intensive training on Good Agricultural Practices (GAP), standardized wooden box fermentation, moisture content control (7–7.5%), and artisan chocolate processing. Using a Participatory Action Research (PAR) approach, the program successfully increased farmers' knowledge by 85%, standardized physical bean quality for export markets, and established value-added local craft chocolate products. This initiative mitigates market price volatility, captures a 185%–300% price margin, and fortifies Kampung Merasa's position as a sustainable premium cocoa producer.



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INTRODUCTION

Merasa Village, located in Kelay District, Berau Regency, East Kalimantan Province, is a key inland plantation hub of high strategic value. Situated within the Kelay River watershed corridor, the area benefits from a tropical forest microclimate and fertile alluvial soils, offering significant potential for cocoa (*Theobroma cacao* L.) cultivation. According to data from the Berau Regency Plantation Office (second semester of 2025), cocoa cultivation in the regency covers a total area of 1,061.10 hectares—comprising 378.6 hectares of immature plants (TBM), 650.5 hectares of productive plants (TM), and 32.0 hectares of old or damaged plants (TT/TR)—with a total production of 514,488.00 kg of dried beans, an average productivity of 790.91 kg/ha/year, and a workforce of 918 people (Dinas Perkebunan, 2025).

While Berau's cocoa generally boasts a track record as "fine flavor cocoa" that successfully penetrates global export markets, price data for plantation commodities from January to April 2026—released by the Berau Regency Plantation Office—reveals a concerning reality for local smallholder farmers in Kampung Merasa. The market for non-fermented cocoa beans (often referred to as **biji asalan** or ungraded beans) saw a drastic price collapse of 54.55%. In January and February 2026, the price of these ungraded beans held steady at IDR 55,000/kg. However, by March 2026, the price had slumped to IDR 35,000/kg, eventually hitting a low of IDR 25,000/kg in April 2026. In stark contrast to ungraded beans, fermented cocoa beans demonstrated resilience and price stability, commanding

significantly higher and more consistent values. During January and February 2026, fermented cocoa was priced at IDR 100,000/kg (representing a price premium or incentive of IDR 45,000/kg over the non-fermented variety). Although prices adjusted downward in March (IDR 90,000/kg) and April (IDR 70,000/kg), the price of fermented beans in April 2026 remained 280% higher—nearly triple—that of non-fermented beans (IDR 70,000 versus IDR 25,000) (Dinas Perkebunan, 2026).

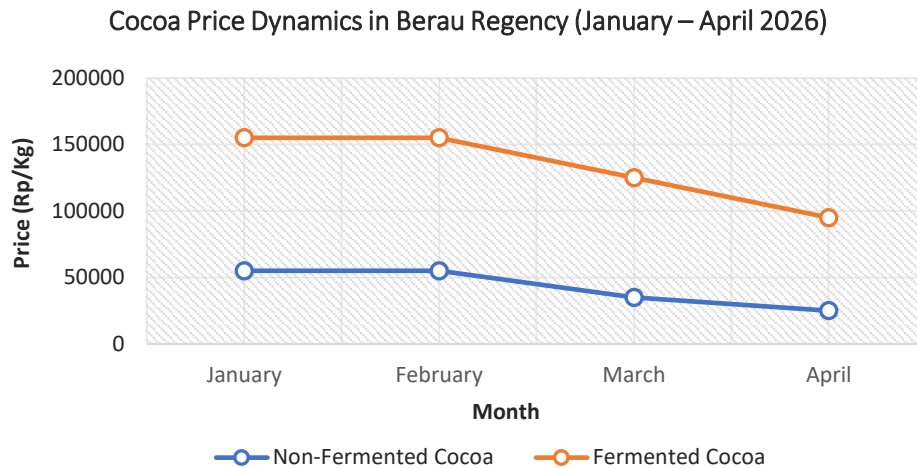


Figure 1. Cocoa Price Dynamics in Berau Regency

This price disparity underscores how the practice among Kampung Merasa farmers of selling cocoa beans using conventional (non-fermented) methods leaves their income highly vulnerable to global market speculation and fluctuations. Without mastery of post-harvest technology, potential earnings of IDR 45,000 to IDR 55,000 per kilogram are simply lost. In light of the massive price gap revealed by the official 2026 data, this Community Service Program (PKM) has been systematically designed with the following objectives:

1. Transformation of post-harvest practices in Kampung Merasa by breaking the habit of selling ungraded, mixed-quality beans through standardized training in Good Agricultural Practices (GAP) and Good Handling Practices (GHP).
2. Standardization of physical quality for export by training farmers to monitor bean moisture levels using digital moisture meters, ensuring compliance with export standards (7.0%–7.5% moisture content).
3. Downstream development of high-value-added products by assisting the Kampung Merasa Women Farmers Group (KWT) in processing fermented beans into craft chocolate and cacao nibs, thereby protecting the local economy against price drops for raw materials at the middleman level.

RESEARCH METHODS

The operational approach employed is community-based Participatory Action Research (PAR). Cocoa farmers and the Women Farmers' Group (KWT) in Kampung Merasa serve as the primary driving forces. The community service program in Kampung Merasa is systematically designed around four interconnected stages: needs assessment, enhancement of cultivation capacity, post-harvest technology transfer, and downstream processing alongside economic impact evaluation.

The initial phase began with cross-sectoral coordination and consolidation involving the Berau Regency Plantation Agency, the Kelay District Agricultural Extension Center (BPP), the Merasa Village Government, and local farmer group representatives (Revulaningtyas, 2020). During this stage, the team presented and disseminated data on official 2026 plantation commodity prices to help residents understand the significant price disparity between fermented and non-fermented cocoa beans (Amran et al., 2018). Additionally, field assessments were conducted to identify plantation productivity levels,

the prevalence of the cocoa pod borer (PBK) pest, and the availability of drying infrastructure in Merasa Village.

The second phase focuses on equipping farmers with theoretical knowledge and practical skills regarding Good Agricultural Practices (GAP) and Good Handling Practices (GHP). Farmers receive training in orchard sanitation to minimize pest infestations, maintenance pruning techniques, balanced fertilization, and the proper method for harvesting fruit at optimal maturity—indicated by the skin turning a uniform yellow or orange. They are also trained to perform initial sorting to separate healthy fruit from defective or diseased fruit prior to seed extraction (Afoakwa, 2016).

The third stage constitutes the core of the post-harvest technology intervention, beginning with the construction of a pilot unit consisting of tiered wooden fermentation boxes made from local, non-aromatic hardwood and equipped with drainage gaps for pulp and aeration holes. Farmers receive guidance on implementing fermentation Standard Operating Procedures (SOPs), which include loading a minimum of 100–200 kg of wet beans, performing periodic turning at the 48-hour mark (Day 3) and on Day 4 to ensure uniform distribution of microbial latent heat (50°C–52°C), and terminating fermentation on Day 5 or 6 (Hatmi & Rustijarno, 2012). The process continues with hygienic sun-drying on raised platforms and periodic moisture content monitoring using a digital moisture meter until a stable level within the 7.0%–7.5% range—meeting export standards—is achieved (SNI, 2008).

The final stage focuses on empowering the Kampung Merasa Women Farmers Group (KWT) through technology transfer for processing fermented cocoa beans into finished products (artisan/craft chocolate). Training covers steps such as roasting, winnowing, conching, and molding—resulting in "Single Origin Merasa" dark chocolate bars and cacao nibs (Fowler, 2008). The team also provides guidance on food-grade packaging and incorporating local branding, facilitates product registration (P-IRT and Halal certification), and measures the program's impact using pre- and post-test evaluations alongside a comparative analysis of the economic value added to the harvest (Revulaningtyas, 2020).

RESULTS AND DISCUSSION

This mentoring program began by strengthening understanding of the political economy of the plantation sector through the open dissemination of official price fluctuation data from the Berau Regency Plantation Office for 2026. This approach proved to be an effective psycho-educational tool for challenging the conventional mindset of farmers in Kampung Merasa, who had long been accustomed to selling wet or unsorted (unfermented) cocoa beans.

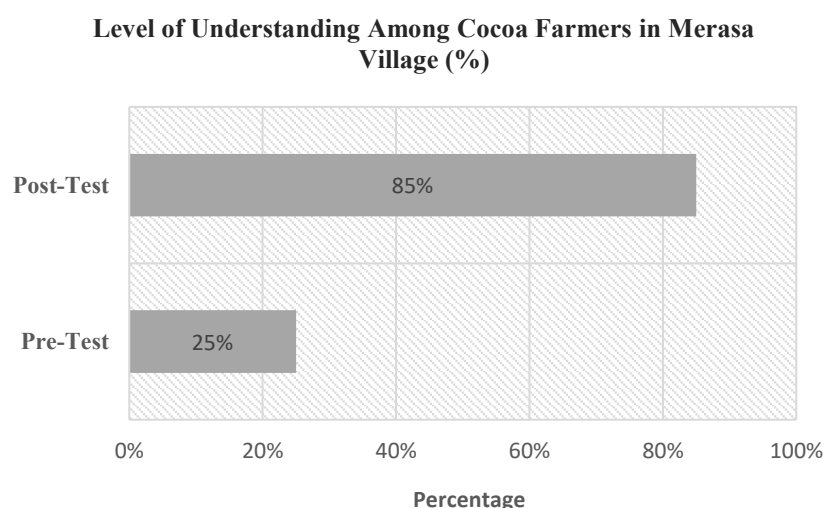


Figure 2. Percentage Level of Understanding Among Cocoa Farmers

Quantitative evaluation results show an increase in the farmers' average understanding score from 25% in the pre-test session to 85% in the post-test (an increase of 60%). Based on descriptive analysis, this leap in understanding encompasses three key cognitive and technical domains.

1. Understanding the biochemical impact of fermentation: it is recognized not merely as a drying step, but as a process that triggers biochemical reactions—specifically the formation of aroma and flavor precursors (such as reducing sugars and free amino acids) within the cocoa beans.
2. Farmers now understand the importance of adhering to processing Standard Operating Procedures (SOPs) regarding critical variables, such as maintaining a minimum fermentation mass (100–200 kg), performing periodic turning at the 48-hour mark and on the fourth day, and ensuring the critical fermentation duration of 5–6 days.
3. Farmers have developed the independent ability to use digital moisture meters to ensure bean moisture levels fall within the 7.0%–7.5% range—a universally recognized safe limit that prevents infestation by *Aspergillus flavus* mold, which produces the toxin Ochratoxin A (OTA) during storage and transport.

The economic assessment focuses on a comparative analysis of price dynamics between unfermented (raw) and fermented cocoa beans from January to April 2026, based on data compiled by the Berau Plantation Office. Analytical findings reveal the extreme vulnerability faced by farmers of unfermented beans during early 2026. The price of non-fermented cocoa beans plummeted by 54.55% over just four months, fluctuating from Rp 55,000/kg in January–February to Rp 35,000/kg in March, before hitting a low of Rp 25,000/kg in April 2026. This decline was driven by weakening local market demand and stricter quality standards imposed by exporters, who rejected "slaty" (unfermented/grey-cored) and moldy beans. In contrast, fermented cocoa beans demonstrated remarkable price resilience. Despite minor market adjustments, prices for fermented cocoa remained in the premium range: Rp 100,000/kg (January–February), Rp 90,000/kg (March), and Rp 70,000/kg (April).

Table 1. Comparison of Quality Characteristics and Economic Implications of Merasa Village Cocoa

Evaluation Parameters	Conventional Method (Non-Fermentation)	Outcomes of Mentoring (Standardized Fermentation)	Impact & Margin Analysis
Structural Profile	Solid (slaty), non-porous, dark purple	Crispy and porous, deep brown in color.	Meets the quality standard parameters of SNI 2323:2008.
Seed Moisture Content	Fluctuating (9% – 12%), prone to mold	7% – 7.5% (Precisely controlled)	Free from microbial contamination and Ochratoxin A
January 2026 Price	Rp 55.000/kg	Rp 100.000/kg	Price advantage +81.8% (+Rp 45.000/kg)
February 2026 Price	Rp 55.000/kg	Rp 100.000/kg	Price advantage +81.8% (+Rp 45.000/kg)
March 2026 Price	Rp 35.000/kg	Rp 90.000/kg	Price advantage +157.1% (+Rp 55.000/kg)
April 2026 Price	Rp 25.000/kg	Rp 70.000/kg	Price advantage +180.0% (+Rp 45.000/kg)
Income Stability	Vulnerable to speculation by middlemen and market fluctuations.	Protected by high-quality incentives.	Ensuring the economic sustainability of smallholders

Viewed from a regional macroeconomic perspective, the Berau region has 1,061.10 Ha of cocoa land with an estimated annual production of 514,488.00 kg of dry beans which employs 918 workers. If the entire production potential is diverted into fermented cocoa, there is the potential to save economic losses or additional income incentives of up to billions of rupiah for inland plantation communities.

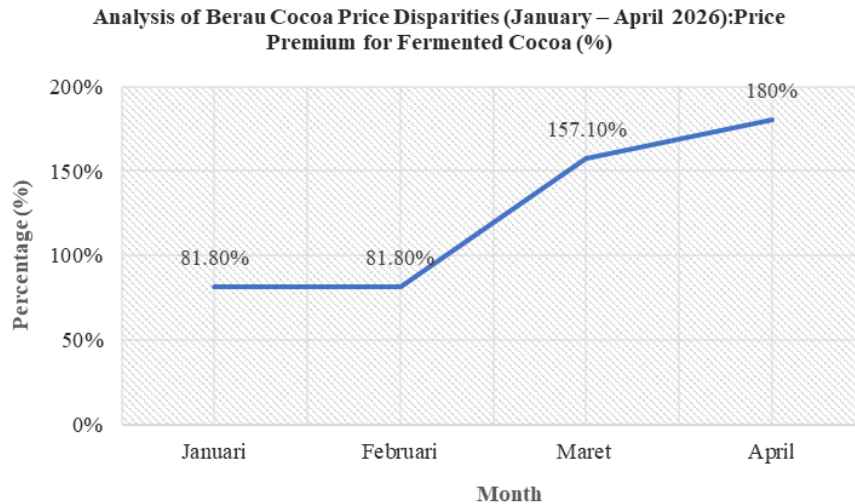


Figure 3. Chart of Berau Cocoa Price Disparity Analysis (January – April 2026)

Beyond improving raw bean quality for the export market, this support program has generated a significant boost in value-added through household-scale downstream processing activities in collaboration with the Kampung Merasa Women Farmers Group (KWT). Grown in the remote Kelay watershed area, Kampung Merasa cocoa beans possess a distinctive natural flavor profile characterized by fruity notes and acidity. Through standardized fermentation and light-to-medium roasting techniques, this unique flavor has been successfully preserved in the "Single Origin Merasa" 70% Dark Chocolate Bar and Cacao Nibs products.



Figure 4. Assistance process for post-harvest cocoa bean management

Economic Value Multiplication (Integrative Ecotourism): Selling fermented cocoa beans as processed artisan chocolate products transforms the raw commodity value (IDR 70,000/kg) into a processed product with an economic value of IDR 200,000 to IDR 300,000 per kilogram equivalent. These products are strategically marketed to capture the market segment of domestic and international tourists visiting the Kampung Merasa ecotourism site.

This program has transformed the role of women farmers in Kampung Merasa from mere observers of plantation activities into key players in value-added post-harvest processing. Establishing this downstream business line not only strengthens the income structure of farming families but also bolsters the village's economic resilience against global commodity price volatility.

CONCLUSION

The Community Service Program (PKM) in Kampung Merasa, Kelay District, Berau Regency, has demonstrated that the implementation of standard-based post-harvest technology is essential to breaking the cycle of economic vulnerability faced by farmers in remote plantation areas. Data on commodity price fluctuations from the Berau Regency Plantation Office for 2026 indicate that reliance on the sale of unfermented (bulk/raw) cocoa beans places farmers in a position of extremely weak bargaining power, as prices plummeted by 54.55%—dropping from IDR 55,000/kg in January–February to IDR 25,000/kg in April 2026.

Support interventions—specifically the implementation of Good Agricultural Practices (GAP) and bean processing using standardized wooden fermentation boxes—have proven to provide a significant price shield. Fermented cocoa beans resulting from this support maintained a price range of IDR 70,000–IDR 100,000/kg, representing a price premium of 81.8% to 180.0% over non-fermented beans during the same period. Furthermore, the assurance of physical quality, with moisture content controlled between 7.0% and 7.5%, met the SNI 2323:2008 standards required for export markets. Downstream processing initiatives—such as the production of "Single Origin Merasa Craft Chocolate" in collaboration with the Women Farmers Group (KWT)—successfully transformed raw cocoa beans into high-value-added products integrated with local ecotourism potential.

REFERENCES

- Afoakwa, E. O. (2016). *Cocoa Production Processing Technology*.
- Amran, Iradhatullah Rahim, & Darmawan. (2018). *PENANGANAN PASCA PANEN KAKAO (THEOBROMA CACAO, L) PADA TINGKAT PETANI DI DESA KALUKKU, KECAMATAN KALUKKU, KABUPATEN MAMUJU Pengetahuan dan Teknologi (SMIPT),. 1(April), 185–190*.
- Dinas Perkebunan. (2025). *REKAPITULASI LUAS AREAL DAN PRODUKTIVITAS TANAMAN PERKEBUNAN ANGKA SEMENTARA SEMESTER 11 TAHUN 2025*.
- Dinas Perkebunan. (2026). *Laporan Hasil Rekapitulasi Harga Komoditi Perkebunan Tahun 2026*.
- Fowler, M. S. (2008). Cocoa Beans: From Tree to Factory. In *Industrial Chocolate Manufacture and Use* (pp. 10–47). <https://doi.org/https://doi.org/10.1002/9781444301588.ch2>
- Hatmi, R. U., & Rustijarno, S. (2012). *TEKNOLOGI PENGOLAHAN BIJI KAKAO MENUJU SNI BIJI KAKAO 01-2323-2008*.
- Indonesia, S. N., & Nasional, B. S. (2008). *Biji kakao*.
- Revolaningtyas, I. R. (2020). PELATIHAN PENGOLAHAN KAKAO OLEH PRAKTISI INTERNASIONAL UNTUK MENINGKATKAN MUTU PRODUK DI KELOMPOK TANI DESA BANJAROYA, KALIBAWANG, KULON PROGO. *Jurnal Pengabdian Dan Pengembangan Masyarakat*, 3(1), 392–399.