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Processing Techniques on the Quality of Cocoa Beans (*Theobroma Cacao L*) in Neniari Village, Seram Barat District

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Abstract: This study aims to analyze the processing techniques of cocoa beans in Neniari Village, Seram Barat District, including harvesting, fermentation, peeling, and drying. The research method used is descriptive, with interviews and field observations involving 12 cocoa farmers. The results show that farmers know the signs of ripe cocoa fruits, but the processing techniques still rely on traditional methods. Most farmers use sunlight to dry cocoa beans and simple tools like machetes to harvest and peel them. Inadequate fermentation and drying techniques affect the quality of cocoa beans. It is recommended that farmers receive training on more modern processing techniques to improve the quality of cocoa beans and competitiveness in the global market.
Keywords: Processing Techniques, Fermentation, Drying

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INTRODUCTION

Indonesia, one of the world's largest cocoa-producing countries, possesses substantial potential to improve the quality of cocoa products through enhanced processing. Cocoa, which plays a vital role in Indonesia's economy, particularly in the plantation sector, contributes significantly to the country's foreign exchange earnings through exports (Laude et al., 2021; Yuningrum, 2016). Nevertheless, the quality of cocoa beans produced at the farmer level in Indonesia remains suboptimal. Farmers often face challenges in processing cocoa beans according to the correct procedures, resulting in low-quality beans (Harsanti et al., 2017). It directly impacts the competitiveness of Indonesian cocoa products in the increasingly competitive international market. Therefore, it is important to focus research on cocoa bean processing techniques at the farmer level, particularly in Neniari Village, Seram Barat District, as part of efforts to improve the quality and market value of cocoa beans (Harsanti et al., 2017; Tajerin, 2017).

One critical stage in cocoa bean processing is harvesting, which must be carried out correctly to maintain bean quality. Determining the ideal harvest age can influence the flavor and quality of cocoa beans (Komariyah, 2019; Tangkelayuk, 2024). In Neniari Village, farmers already possess basic knowledge regarding the signs of ripening in cocoa fruit, such as changes in pod color (Hafiz & Verawati, 2021; Kusmiah,

2019). However, there remains a gap in understanding more efficient harvesting techniques, which can affect the quality of the resulting beans. Therefore, educating and training farmers regarding proper harvesting techniques is essential to improve the quality of cocoa beans produced (Aji et al., 2021; Huda, 2021).

After harvesting, cocoa beans must be processed promptly to preserve their quality. One necessary process is fermentation, which aims to reduce bitterness and develop the characteristic flavor of cocoa (Kasim & Kalsum, 2018; et al., 2017). The fermentation process employed by farmers in Neniari Village still uses traditional methods that may affect cocoa bean quality. Yet, fermentation using the correct techniques can produce higher-quality cocoa beans, ultimately increasing their market value (Mutiara et al., 2023; Ngatirah et al., 2024). Knowledge of proper fermentation is essential to improve the quality of cocoa beans produced. Training on sound fermentation techniques needs to be provided to farmers so that they can produce cocoa beans with optimal flavor.

In addition to fermentation, drying techniques represent a crucial stage in cocoa bean processing. Improper drying of cocoa beans can result in damage or fungal contamination, undoubtedly reducing their quality (Sinaga, 2021; Ogundare et al., 2022; Banboye et al., 2020). Most farmers in Neniari Village still rely on sunlight to dry cocoa beans. Although this method is quite adequate, using more efficient modern drying equipment could enhance the quality of cocoa beans (Khathir et al., 2022; Guda et al., 2017; Kotey et al., 2022). Several modern methods, such as vacuum drying and heat pump drying, have also been proven to preserve bioactive compound content and significantly enhance the flavour profile of cocoa (Rahman et al., 2012; Hii et al., 2011). Therefore, this study aims to explore the application of more advanced drying techniques and provide training to farmers to improve the quality of cocoa beans produced.

Furthermore, post-harvest processing of cocoa beans also involves separating the beans from their shells, which is often done manually using machetes or axes (Umrah et al., 2023; Elake et al., 2024). Although farmers in Neniari Village still use this method, more modern tools to crack cocoa pods could accelerate the process and reduce bean damage (Singapurwa et al., 2022; Saïdou et al., 2021). In addition, incomplete separation of cocoa bean shells can lead to a decrease in the final product's quality, necessitating improvements in separation techniques (Laude et al., 2021; Kim-Ngoc et al., 2022).. Therefore, this study will also focus on developing more effective and efficient bean separation techniques.

Overall, improving the quality of cocoa bean processing in Neniari Village requires a comprehensive approach involving the enhancement of harvesting, fermentation, drying, and bean separation techniques. By increasing farmers' knowledge and skills regarding these techniques, the quality of cocoa beans produced is expected to improve and provide more excellent added value for farmers and the cocoa processing industry (Harsanti et al., 2017). This study seeks to contribute by identifying and developing improved cocoa bean processing techniques, which will enhance the competitiveness of Indonesian cocoa products in the global market.

METHOD

The research employed a descriptive approach to provide a detailed depiction of the current conditions regarding cocoa bean processing techniques in Neniari Village, Seram Barat District. This approach was chosen as it offers a clear overview of the cocoa processing practices adopted by local farmers. The study was conducted in the field to gather relevant data that accurately reflect the actual conditions in Neniari Village. Through this method, the researchers explored various stages of cocoa bean processing, including harvesting, fermentation, peeling, and drying.

The study occurred in Neniari Village, located in Seram Barat District, West Seram Regency, which holds significant potential for cocoa production. The research was carried out between March and April 2024, a period sufficient to observe the cocoa farming cycle and the techniques employed by farmers in

processing their cocoa beans. The data obtained from this study are expected to provide accurate insights into the cocoa processing techniques used in the region. The site was selected due to the prevalence of traditional processing methods among local cocoa farmers, making it a valuable subject for further investigation.

The research population comprised all cocoa farmers in Neniari Village, which is estimated to be approximately 60 individuals. From this population, a sample of 40%, or 24 farmers, was randomly selected to represent various characteristics, including age, education level, and farming experience. This sampling method was intended to obtain a more comprehensive and representative understanding of the cocoa processing practices in the village.

Primary data were collected directly from farmers through in-depth interviews and field observations. The interviews sought to gather information on the techniques used by farmers in the stages of cocoa processing, from harvesting and fermentation to peeling and drying. Field observations were conducted to witness firsthand the cocoa processing practices at the study site. In addition, documentation such as records or reports related to cocoa processing was used as supplementary data to provide further context for the findings.

A qualitative descriptive technique was employed for data analysis. Data collected through interviews and observations were analyzed by identifying key themes emerging from cocoa processing activities in Neniari Village. These findings were then structured into a straightforward narrative that describes the techniques farmers apply and the challenges they encounter in the processing stages. The analysis also involved comparisons between traditional methods used by farmers and more modern techniques that could potentially enhance cocoa bean quality. Data were presented as tables and graphs to facilitate understanding and interpretation of the research results.

RESULTS AND DISCUSSION

1. Determination of Harvest Maturity

Based on the research conducted in Neniari Village, the determination of cocoa fruit harvest maturity is done by observing the ripening of the fruit, which usually takes 5–6 months from the time the flowers bloom. Farmers in this village tend to wait until the cocoa pod turns yellow, indicating it is ready for harvest. Knowledge of the harvest age is essential because it affects the quality of the resulting cocoa beans. The respondents' knowledge of harvest maturity is presented in the following table.

Table 1. Knowledge of Harvest Maturity Among Respondents

No	Response	F	%
1	Very knowledgeable	6	50.00
2	Knowledgeable	5	41.66
3	Less knowledgeable	1	8.33
4	Not knowledgeable	0	0.00
	Total	12	100.00

Source: Research Findings, 2024

Table 1 shows the level of respondents' knowledge about the cocoa fruit harvest age in Neniari Village. As many as 50% of respondents (6 people) were very knowledgeable, while 41.66% (5 people) stated they were knowledgeable. Only 8.33% (1 person) felt less knowledgeable, and no respondents said they did not. This data shows that most farmers in Neniari Village have good knowledge about determining harvest age, essential for ensuring optimal cocoa bean quality and supporting successful production. The respondents' knowledge of the characteristics of ripe cocoa fruit is presented in the following table.

Table 2. Knowledge of Characteristics of Ripe Cocoa Fruit Among Respondents

No	Response	F	%
1	Colour change	10	83.33
2	Large size	2	16.66
3	Dried peduncle	0	0.00
4	Audible sound when shaken	0	0.00
	Total	12	100.00

Source: Research Findings, 2024

Table 2 illustrates the respondents' knowledge concerning the characteristics of

ripe cocoa pods in Neniari Village. A significant proportion of farmers, precisely 83.33% (10 individuals), recognized color change as the primary indicator of ripeness. It suggests that visual cues, particularly changes in the pod's external appearance, serve as the most accessible and widely understood method for determining harvest readiness among local farmers. Meanwhile, 16.66% (2 respondents) considered the pod size a sufficient marker of maturity. Notably, no participants identified other potential indicators, such as the drying of the fruit stalk or the presence of an internal sound when the pod is shaken, which are also acknowledged in cocoa agronomy as valid maturity signals.

These findings reveal that while a basic level of understanding regarding pod maturity exists among farmers in Neniari Village, their reliance remains predominantly on a singular, visual-based indicator. The absence of knowledge about supplementary maturity cues may reflect a gap in technical training or limited exposure to more comprehensive harvesting guidelines. This narrow dependence could lead to inconsistencies in determining the optimal harvest time, especially in cases where the color change is ambiguous or delayed due to environmental factors. Therefore, educational outreach and training initiatives aimed at broadening farmers' knowledge of diverse ripeness indicators would be beneficial in enhancing harvesting accuracy and ultimately improving bean quality.

2. Harvesting Techniques

Based on the research results, it was found that the people of Neniari Village harvest cocoa fruit using various simple tools. Most farmers rely on machetes or knives to cut the cocoa pod stalks, which are considered the most effective and practical. Some farmers also use fruit pickers to harvest pods located at hard-to-reach heights, although this tool is less common than machetes. In addition, farmers occasionally climb cocoa trees manually to reach pods located at the top. Although this method is simple, it is still quite effective for harvesting, even though it does not consider time efficiency and safety. Thus, there is a need to introduce more modern harvesting tools to improve farmer productivity and safety. The methods used by respondents to harvest cocoa are shown in the following table.

Table 3. Cocoa Pod Harvesting Methods Used by Respondents

No	Method	F	%
1	Stalks cut	9	75.00
2	Twisted by hand	2	16.66
3	Picked using a fruit picker	0	0.00
4	Cut using pruning shears	1	8.33
	Total	12	100.00

Source: Research Findings, 2024

Table 3 presents the cocoa harvesting methods employed by respondents in Neniari Village. A substantial proportion of farmers, 75% (9 individuals), reported using cutting tools such as machetes or knives to sever the cocoa pod stalks. This method is perceived as efficient and contributes to preserving the plant's health by avoiding excessive physical damage to the branches. Cutting tools are widely accessible and familiar to the farmers, making them a practical and preferred choice. Meanwhile, 16.66% (2 respondents) harvested the pods by twisting them by hand—an approach that, although simple, carries the risk of damaging the stalk and potentially reducing future yields. Only 8.33% (1 respondent) utilized pruning shears, a method considered more refined but less commonly adopted due to limited availability or awareness.

The complete absence of the fruit picker method among respondents further underlines the prevailing reliance on basic manual techniques within the village. It suggests that the mechanization or modernization of harvesting practices has yet to reach these farming communities meaningfully. While the current tools are functional, their limited ergonomics and potential to cause plant stress or injury highlight the need for training in safer and more sustainable harvesting methods. Promoting the adoption of appropriate and affordable tools, along with farmer education, could improve harvesting efficiency, reduce plant damage, and potentially enhance

overall productivity in the cocoa farming sector of Neniari Village.

The tools used in the cocoa harvesting process by respondents are shown in the following table.

Table 4. Tools Used for Cocoa Harvesting by Respondents

No	Tool	F	%
1	Machete/knife	8	66.66
2	Pruning shears	1	8.33
3	Sickle	1	8.33
4	Fruit picker	2	16.66
	Total	12	100.00

Source: Research Findings, 2024

Table 4 displays the types of tools respondents in Neniari Village use for harvesting cocoa. Most farmers, 66.66% (8 individuals), reported using machetes or knives as their primary instruments for cutting cocoa pod stalks. These tools are favored for their practicality, affordability, and availability within local farming communities. They require minimal maintenance, are easy to handle, and have long been embedded in traditional agricultural practices. This widespread use reflects not only the accessibility of such tools but also a reliance on methods that require little to no technical training.

In contrast, a smaller proportion of respondents, 16.66% (2 individuals), employed fruit pickers to access cocoa pods located on higher branches—an approach demonstrating an awareness of alternative tools, albeit on a limited scale. Only 8.33% (1 respondent each) reported using pruning shears and sickles, suggesting that more refined or specialized tools have yet to gain traction among local farmers. Overall, the findings indicate that harvesting practices in Neniari Village remain centered around essential manual tools. While these are effective to a certain extent, introducing ergonomic, efficient, and safer equipment and appropriate training could enhance harvesting precision, reduce plant damage, and support long-term productivity in cocoa farming.

3. Peeling Techniques

Peeling cocoa beans in Neniari Village is carried out after the pods are harvested and gathered into a pile. The peeling process begins by splitting the fruit using a machete chosen for its sharpness and ease of cutting through the thick pod shell. Some farmers also use wooden sticks to knock the cocoa pods to facilitate splitting. The tools used in this process are knives, machetes, and other sharp objects designed to simplify the separation of beans from the pod. Although this method still uses simple tools, it is pretty effective, though modern processing techniques could improve the efficiency and the quality of the cocoa beans produced. The methods used by respondents to peel cocoa are presented in the following table.

Table 5. Methods Used for Peeling Cocoa Pods by Respondents

No	Method	F	%
1	Split using machete	9	75.00
2	Knocked with a wooden stick	1	8.33
3	All incorrect	0	0.00
4	All correct	2	16.66
	Total	12	100.00

Source: Research Findings, 2024

Table 5 outlines the various methods employed by respondents in Neniari Village to peel cocoa pods. A significant majority of farmers, 75% (9 individuals), preferred to split the pods using a machete, which is widely regarded as both the most efficient and accessible method. The machete enables farmers to quickly and effectively break open the tough pod shell with minimal effort, making it an ideal tool given the practical constraints of rural farming environments. Additionally, 16.66% (2 respondents) reported combining machete-splitting and knocking the pods with wood, suggesting a degree of adaptability in their techniques based on pod condition or individual preference.

Interestingly, 8.33% (1 respondent) relied solely on wooden tools to open the pods, reflecting the continued presence of rudimentary methods. No respondents indicated that any peeling methods were

incorrect, demonstrating general satisfaction with their current practices. These findings collectively illustrate that cocoa pod peeling in Neniari Village still heavily relies on bare, manually operated tools such as machetes and wooden implements. While these tools are sufficient for small-scale processing, they may limit efficiency and consistency in output, underscoring the potential benefit of introducing improved technologies or tools designed for smallholder cocoa farmers.

The objects respondents use to peel cocoa are presented in the following table.

Table 6. Tools Used for Peeling Cocoa Pods by Respondents

No	Tool	F	%
1	Wooden block	1	8.33
2	Knife or machete	10	83.33
3	Axe	1	8.33
4	Other sharp objects	0	0.00
	Total	12	100.00

Source: Research Findings, 2024

Table 6 presents the tools used by respondents for peeling cocoa pods in Neniari Village. An overwhelming majority of farmers, 83.33% (10 individuals), relied on knives or machetes as their primary tools. These implements are favored for their ease of access and proven effectiveness in penetrating the tough outer shells of cocoa pods. Their widespread use reflects not only the practicality and affordability of such tools in rural farming settings but also the longstanding familiarity of farmers with these traditional implements. Given their simplicity and minimal maintenance requirements, knives and machetes remain the default option for many smallholder cocoa producers.

In contrast, only a small number of respondents reported using alternative tools. Specifically, 8.33% (1 individual) used wooden blocks, while another 8.33% employed axes in peeling. The absence of other specialized or mechanized tools suggests limited exposure to or availability of improved equipment for pod processing in the area. These findings reinforce the dominance of simple, manual tools—mainly knives and machetes—in cocoa processing practices within Neniari Village.

4. Fermentation (Removing Pulp from Beans)

Based on the research conducted in Neniari Village, the fermentation technique for removing the pulp from cocoa beans shows that farmers use their hands as the primary method. Most farmers believe using their hands allows them to separate the beans from the pulp more carefully and efficiently, keeping the cocoa beans intact and undamaged. Some farmers also use spoons to aid the process, although this method is less common than using hands. This technique is carried out after the cocoa pod is split, and the pulp attached to the beans is removed to prepare them for fermentation. Although this method is simple, it is essential to ensure the cleanliness of the beans so the fermentation process proceeds well and results in high-quality cocoa beans. The techniques used by respondents for removing the pulp from cocoa beans are shown in the following table.

Table 7. Techniques Used to Remove Pulp from Cocoa Beans by Respondents

No	Method	F	%
1	Using hands	10	83.33
2	Using wooden tools	0	0.00
3	Using spoon	2	16.66
4	Others	0	0.00
	Total	12	100.00

Source: Research Findings, 2024

Table 7 outlines the techniques employed by respondents in Neniari Village to remove the pulp from cocoa pods. A substantial majority, 83.33% (10 individuals), reported using their hands as the primary method for extracting cocoa beans. This manual technique is widely regarded as more effective because it minimizes the risk of damaging delicate beans during the separation process. Hand extraction allows farmers to exercise greater control and precision, which is crucial for maintaining the quality of the beans before they undergo fermentation. The preference for this method also reflects the accessibility and practicality of hand-based techniques in smallholder farming systems where specialized equipment is scarce.

In contrast, only 16.66% of respondents (2 individuals) reported using spoons to extract cocoa beans from the pods. While this method can offer a degree of ease in scooping out the pulp, it is less common and may be seen as supplementary rather than primary. Notably, none of the respondents used wooden tools or other alternative methods, suggesting a limited diversification in techniques. These findings indicate that manual, hand-based extraction remains the most dominant and trusted approach in Neniari Village. Although effective, there may be opportunities to introduce low-cost, ergonomic tools to support efficiency and hygiene without compromising bean integrity.

The methods used by respondents to remove the mucilage from the pulp are presented in the following table.

Table 8. Methods Used to Remove Mucilage from Cocoa Beans by Respondents

No	Method	F	%
1	Washed	5	41.66
2	Pressed using stones	4	33.33
3	All correct	3	25.00
4	All incorrect	0	0.00
	Total	12	100.00

Source: Research Findings, 2024

Table 8 shows how respondents remove the mucilage from the cocoa pulp. 41.6% of respondents (5 people) washed the cocoa beans to remove the mucilage, which is considered the most effective method to maintain bean cleanliness. Meanwhile, 33.3% of respondents (4 people) used stones to press the beans as an alternative method of mucilage removal. As many as 25% of respondents (3 people) used washing and pressing with rocks. No respondents considered their method incorrect. These results show that most farmers prefer washing the cocoa beans as the primary method to remove mucilage.

6. Drying Techniques

Based on the research conducted in Neniari Village, the drying of cocoa beans still relies on sunlight as the primary method. Farmers in this village dry cocoa beans under direct sunlight, which is considered the most practical and economical method. The surfaces commonly used for drying cocoa beans include tarpaulin, which helps maintain bean cleanliness during drying. Some farmers also use zinc sheets and drying racks (para-para) as alternative drying platforms, although these are not widely used. Despite its common usage, sun drying alone can affect the quality of cocoa beans, particularly under unpredictable weather conditions. Therefore, using more modern drying equipment could improve the quality of cocoa beans produced. The methods used by respondents to dry cocoa beans are shown in the following table.

Table 9. Methods Used to Dry Cocoa Beans by Respondents

No	Method	F	%
1	Asphalt	7	58.33
2	Tarpaulin	5	50.00
3	Drying rack	0	0.00
4	Zinc sheet	0	0.00
	Total	12	100.00

Source: Research Findings, 2024

Table 9 shows the methods used by respondents to dry cocoa beans in Neniari Village. Most respondents, 66.6% (8 people), chose to dry cocoa beans under direct sunlight as their preferred method. Meanwhile, 33.3% of respondents (4 people) selected the option "all correct," possibly indicating they used a combination of methods, although none used mechanical dryers. No respondents reported using mechanical dryers or other drying techniques. These results suggest that cocoa bean drying techniques in Neniari Village still rely heavily on natural sunlight.

The places respondents use to dry cocoa beans are shown in the following table.

Table 10. Places Used to Dry Cocoa Beans by Respondents

No	Place/Method	F	%
1	Sun-dried	8	66.66
2	Drying (general)	0	0.00
3	Using a mechanical dryer	0	0.00
4	All correct	4	33.33
	Total	12	100.00

Source: Research Findings, 2024

Table 10 shows the places used by respondents to sun-dry cocoa beans in Neniari Village. Most respondents, 58.33% (7 people), used asphalt surfaces as a drying platform. It may be due to asphalt's heat absorption properties, although it is not ideal from a hygiene standpoint. Meanwhile, 50% of respondents (5 people) used tarpaulin, which is cleaner and helps minimize contamination of the cocoa beans. No respondents reported using drying racks or zinc sheets. These findings indicate that asphalt and tarpaulin are the most commonly used drying platforms among farmers in this village.

B. Discussion of Research Findings

1. Cultivation Techniques

Cocoa cultivation in Neniari Village focuses on improving the plants' growth and development to achieve optimal yields. However, the condition of cocoa plants in this village indicates that many trees are already old and damaged, affecting the quality and productivity of the cocoa beans. Aged trees tend to yield beans of less-than-optimal size and quality, impacting farmers' income. To address this issue, one of the solutions that can be implemented is replanting—replacing old cocoa plants with new ones. This replanting process is expected to rejuvenate unproductive trees and improve the quality and yield of cocoa beans, thereby enhancing farmers' income and the competitiveness of cocoa products in the market.

2. Determination of Harvest Maturity

Harvesting and post-harvest processing are crucial aspects of cocoa cultivation because they directly affect the quality of the beans produced. Even if cocoa production is high, if harvesting and processing are not carried out properly, the resulting cocoa bean quality will decline. It may result in low purchase prices or even rejection by buyers. Post-harvest handling, from fruit picking to cocoa bean processing, ensures optimal bean quality. Therefore, the implementation of appropriate harvesting and processing methods is necessary so that the resulting beans meet market quality standards and can compete with cocoa products from other regions. Good post-harvest practices also play a role in determining the selling price of cocoa beans, which can vary depending on bean quality and buyers' acceptance.

3. Harvesting Techniques

Cocoa pods are harvested after reaching maturity, which is indicated by a change in pod color. Unripe green pods will turn yellow when ripe, while initially, red pods will change to orange. There are typically one or two prominent harvest peaks in a year, usually occurring 5 to 6 months after a seasonal shift. In some villages, harvesting is done throughout the year, depending on the condition of the plants. After harvesting, the cocoa fruits are sorted into good and bad ones. Poor-quality fruits include those that are overripe, pest- or disease-infested, immature, or past maturity. Harvesting is usually carried out 5 to 6 times during a peak harvest season, with an interval of approximately one week. To maintain cocoa bean quality, 100 kg of fresh fruit is needed for fermentation, ensuring optimal post-harvest processing.

CONCLUSION

This research shows that the cocoa bean processing techniques applied by farmers in Neniari Village still heavily rely on traditional methods. Although farmers are already aware of the signs indicating that cocoa pods are ready for harvest and most understand the correct way to harvest the pods, the techniques used in cocoa bean processing—such as fermentation, peeling, and drying—still require improvement. The use of more modern tools in processing, such as devices for cracking and separating cocoa shells, can enhance the efficiency and quality of the cocoa beans. Furthermore, cocoa bean drying depends solely on sunlight and must be supported by better methods to prevent damage and contamination. Enhancing farmers' knowledge and training in more modern processing techniques is expected to improve the quality of cocoa beans, thereby increasing farmers' income and the competitiveness of cocoa products in the global market.

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