
TRANSFORMASI KUALITAS SUSU MELALUI INTEGRASI PADANG PENGEMBALAAN, HIGIENE, DAN KESEHATAN HEWAN: ADAPTASI PRAKTIK DARI AJ INVESTMENT DAIRY FARM, SELANDIA BARU

TRANSFORMATION OF MILK QUALITY THROUGH THE INTEGRATION OF PASTURE, HYGIENE, AND ANIMAL HEALTH: ADAPTING PRACTICES FROM AJ INVESTMENT DAIRY FARM, NEW ZEALAND

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Abstract. The high volume of milk imports in Indonesia, reaching 28,280.61 tons per month, highlights the urgent need for improving the efficiency and quality of domestic dairy production systems. This study aims to analyze the implementation of integrated pasture-based management at AJ Investment Dairy Farm, New Zealand, and to formulate an adaptive strategic framework for optimizing milk quality in Indonesia. A descriptive-qualitative approach with an observational design was used to evaluate the integration of pasture-based nutrition, milking hygiene, and animal health management. The findings show that a structured paddock rotation system supported by 93% feed self-sufficiency resulted in a total production of 219,827 kg of milk solids (kgMS), with an average of 379 kgMS per cow and 1,010 kgMS per hectare. The stability of milk fat and protein content was closely associated with consistent Body Condition Scores within the ideal range of 4-6 and a low incidence of health disorders ($\pm 2\%$), indicating balanced nutritional intake and effective herd health management. Milk quality was maintained within safe microbiological limits through systematic sanitation of milking equipment and the application of multi-stage filtration, despite the absence of teat dipping practices. These findings confirm that the synergy between pasture management, hygiene control, and animal health plays a critical role in sustaining milk quality and production efficiency. Therefore, this integrated system can serve as a practical and scalable model for Indonesian dairy development through land-based forage optimization, controlled grazing, and comprehensive health and hygiene management to support national milk self-sufficiency.

Keywords: *Animal health, Dairy cattle, Milking hygiene, Milk solids, Pasture management.*

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INTRODUCTIONS

Based on data from Badan Pusat Statistik (2026), milk is one of the livestock commodities with the highest import rate in Indonesia, with a volume of around 28,280.61 tons per month. This high dependence on imports stems from the limited production of Domestic Fresh Milk, which can only meet around 21% of national demand (Direktorat Jenderal Peternakan dan Kesehatan Hewan, 2024). Although the national dairy cow population reaches 499,360 heads, productivity at the smallholder level is still not optimal, with an average production of only 11.86 ± 4.90 kg per head per day (Isdarwanto *et al.*, 2025). This low productivity and milk quality are significantly influenced by the suboptimal integration of feed management, hygiene standards, and systematic livestock health maintenance (Efendi *et al.*, 2020).

Improving management systems is a crucial approach to increasing the economic value of milk, particularly through increasing milk solids such as fat and protein content and reducing microbiological contamination. Variations in milk quality between farms in Indonesia are often caused by inconsistent management practices. Therefore, it is necessary to identify evidence based management practices that cover nutrition, hygienic milking procedures, and comprehensive livestock health monitoring. A study of efficient and sustainable farming systems is needed to formulate an applicable model for the development of the national dairy sector (Gaikwad and Ghule, 2025).

New Zealand is globally recognized as a leader in efficient and sustainable pasture-based dairy farming systems. The country's success is supported

by planned grazing management that ensures the availability of high-quality nutrition throughout the year. In addition to feed aspects, the superior quality of milk in New Zealand is also determined by the implementation of strict milking hygiene standards and proactive livestock health monitoring to ensure animal welfare and stable productivity (Cartmill and Donaghy, 2024). AJ Investment Dairy Farm in New Zealand is one of the business units that optimally implements the integration of these pillars, making it a relevant object of study for adaptation.

Pasture-based dairy systems are characterized by integrated farm management that directly influences milk quality and its suitability for processing. Pasture management determines feed nutritional composition, affecting milk fat and protein synthesis. These effects must be supported by proper milking hygiene to maintain microbiological quality and effective herd health management to ensure optimal udder function (Correa - Luna *et al.*, 2021; Neave *et al.*, 2022). This study aims to analyze management practices at AJ Investment Dairy Farm to provide adaptive recommendations for Indonesia. By integrating pasture management, hygiene, and livestock health, it is hoped that national milk production efficiency and quality can be improved sustainably to strengthen Indonesia's food self-sufficiency.

MATERIALS AND METHODS

1. Research Approach and Design

This study used a descriptive-qualitative approach with an observational design to assess the effect of dairy cow maintenance management practices on milk quality, particularly milk solids. Data were collected thro-

ugh direct observation of nutritional sources (pasture availability and supplementary feeding), milking hygiene (udder cleanliness, milking equipment sanitation, and milking procedures), and livestock health (physical condition, Body Condition Score, and health records). Milk solids values, including fat, protein, and total milk solids, were obtained from farm production records.

2. Research Materials

This research focuses on lactating dairy cows raised under a pasture-based management system, with the main data collected including milk solids (percentage of milk fat and protein) as indicators of production quality. In addition, supporting variables observed include the nutritional aspects of forage and supplementary feed, milking hygiene standards, and overall animal health status to identify correlations between husbandry management practices and milk quality.

3. Data Collection Methods

Data collection methods were carried out through a combination of direct field observations and the use of secondary data from farm management. Observations were made to qualitatively assess the implementation of milking hygiene, the physical health of livestock, and the effectiveness of the pasture-based feeding system. Meanwhile, secondary data was obtained from company records covering daily milk production volume, total milk solids value, livestock health records, and an overview of the farm to provide a comprehensive understanding of the research variables.

4. Research Variables

To better illustrate the relationships among the key variables examined in this study, a conceptual framework is presented in Figure 1.

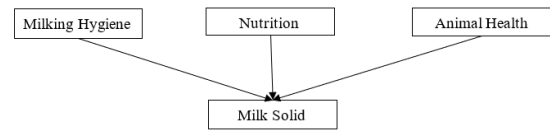


Figure 1. Conceptual Framework of Factors Influencing Milk Solid Content

5. Data Collection Methods

Data analysis was conducted descriptively and qualitatively using an in-depth observational approach to examine maintenance management practices at AJ Investment Dairy Farm. The process began with data reduction, focusing on three main pillars: pasture-based nutrition management, milking hygiene standardization, and holistic livestock health monitoring. Qualitative observations of operational procedures, such as paddock rotation, milking machine sanitation, and livestock health management were integrated with milk solids (fat and protein) production records and farm recording data to explore causal relationships between maintenance management and milk quality. Management variables were operationally defined and categorized into pasture management, milking hygiene, and animal health, with each variable described based on observed practices, farm records, and recorded conditions to ensure consistent interpretation. Finally, the data were interpreted to assess the effectiveness of the management system, which informed the development of an adaptive strategic framework for improving milk quality in the Indonesian context.

RESULTS AND DISCUSSION

1. Results

1.1 Operational Profile and Maintenance System

The company, located in Invercargill, Awarua Wetland, Marshall Road, Southland, New Zealand, manages a total land area of 1,000 ha with a total population of 4,000 cows. Within this area, the research focuses on a specific unit consisting of a total area of 223.11 ha with an effective production area of approximately 222.23 (59 effective paddocks) ha and a peak population of 580 lactating cows. The production system implemented is seasonal calving with twice-daily milking using a 64-bale rotary milking shed. The main feed source comes from natural pastures managed through a planned paddock rotation system. Paddock rotation is conducted after each milking session, moving cows to paddocks where the grass is mature, ready for grazing, and free from weeds. Feed from the company's own land contributes approximately 93%, while additional supplementation is provided on a limited basis according to the physiological needs of the livestock. This maintenance system emphasizes efficient utilization of forage and routine control of livestock health.

1.2 Milk Solid

Total milk solids production reached 219,827 kgMS. Average production per head was recorded at 379 kgMS per lactation period, while production per hectare reached 1,010 kgMS. The milk solids components observed consisted of milk fat and protein content, which were routinely recorded by farm mana-

gement. Milk solids values showed a pattern of fluctuation that followed the lactation phase and pasture growth dynamics. During the peak production period, daily milk volume increased in line with the availability of high-quality forage. In general, the data showed consistency in milk solids production during the field observation period.

1.3 Nutrition Management

Observations show that grazing is carried out rotationally with intervals adjusted according to grass growth. Grass height before and after grazing is monitored to maintain the nutritional quality consumed by livestock. Pasture is the main source of energy and protein, so the quality of forage greatly determines milk production performance. The dominant grass types used in the pasture system include perennial ryegrass (*Lolium perenne*), Italian ryegrass (*Lolium multiflorum*), and cocksfoot (*Dactylis glomerata*). Legumes commonly grown as natural protein sources are white clover (*Trifolium repens*) and red clover (*Trifolium pratense*), which play a role in increasing soil nitrogen content through biological fixation. The combination of grass and legumes supports optimal metabolic energy and crude protein availability for lactating cows. Supplementary feeding is carried out selectively in the early stages of lactation or when grass growth declines, so that the balance between livestock energy requirements and land production capacity is maintained and reflected in the relatively consistent Body Condition Score of cows during the observation period.

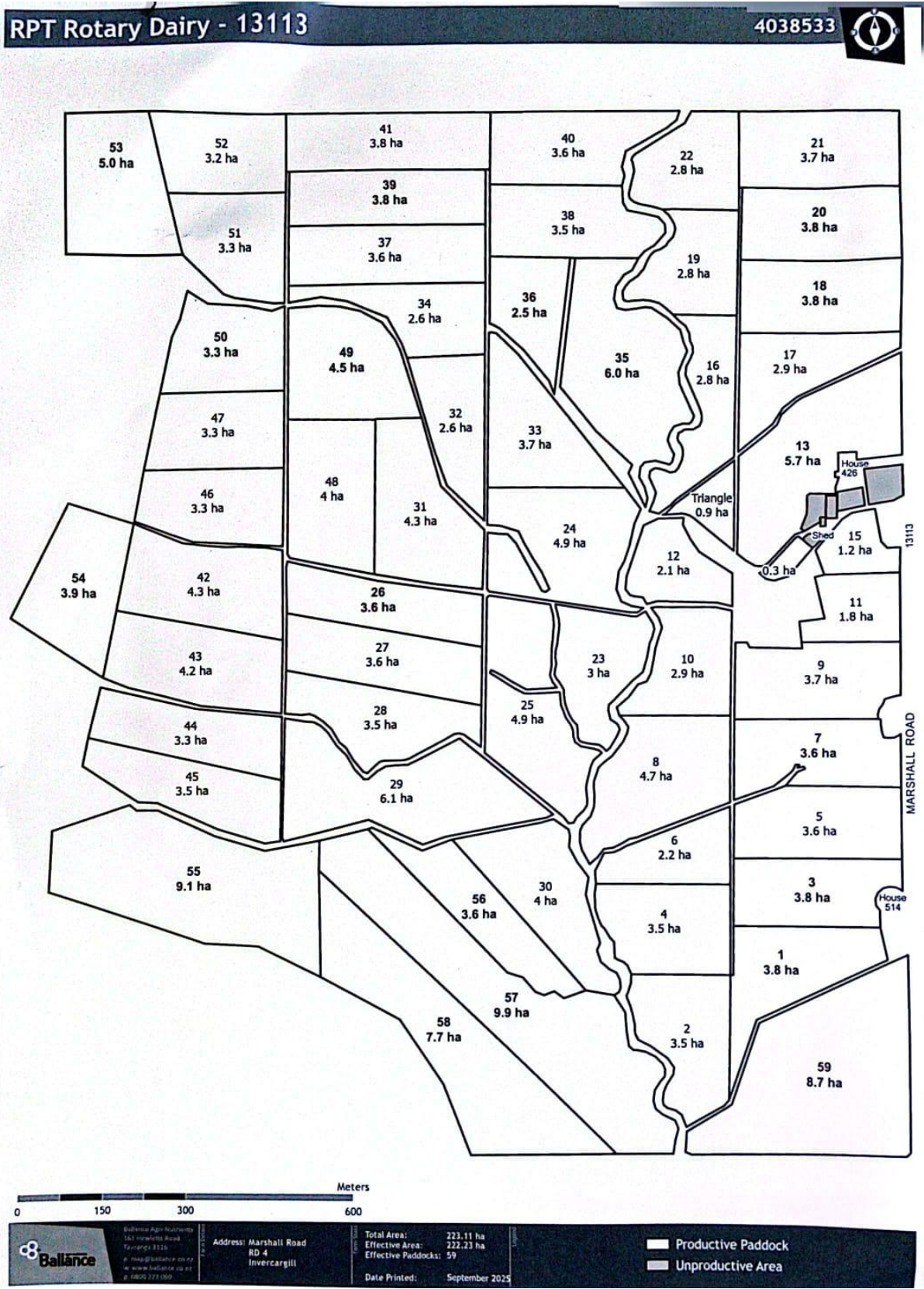


Figure 2. Map of the study area at AJ Investment Dairy Farm

1.4 Milking Hygiene

Milking practices are carried out using standardized and consistent hygienic procedures in accordance with farm operating standards. In addition to cleaning before milking, the farm also performs re-cleaning after milking to maintain cleanliness. The milking machine system is cleaned and sanitized after each milking, while thorough sanitation (deep cleaning) is performed once a week. The sanitation process includes washing the milk lines, liners, and collector units using cleaning solutions that meet industry standards. This system also has a filter in the milk flow line before it enters the milk cooler, which serves to filter out foreign particles or fine dirt so that the physical quality of the milk is maintained until the cooling stage. During the observation period, the farm did not use teat dipping methods either before or after milking, so hygiene control was more focused on manual washing procedures, filtration systems, and equipment sanitation. No indications of hygiene issues were found during the observation, and these conditions support the microbiological quality of the milk remaining within safe limits and consistent with production quality standards.

1.5 Animal Health

The general health condition of livestock is categorized as good based on farm records and field observations. Of the total 580 lactating cows, 12 ($\pm 2\%$) were placed in a separate paddock due to health problems, including several cases of mastitis. Cows with mastitis were still milked to reduce udder pressure, but the milk produced was immediately discarded and not mixed into the main tank to maintain produc-

tion quality. Treatment was carried out by administering medication in accordance with livestock health procedures until the cows were declared recovered, and during the recovery period, the cows were only milked once a day to reduce physiological stress. The separation of sick cattle and disposal of milk from infected cows reflect the application of the precautionary principle in maintaining the quality and safety of dairy products.

The Body Condition Score (BCS) of lactating cows is in the range of 4-6 according to guidelines from DairyNZ (Macdonald & Roche, 2024), which is considered ideal. This range indicates a balance between production needs and the physical condition of the cattle, thereby supporting optimal milk production. Mastitis monitoring is conducted routinely through udder condition checks, daily health records, and veterinary examinations to ensure cows remain in ideal condition for recovery. Overall, udder disorder incidence is relatively low compared to the total population, and herd health stability contributes to the consistency of milk solids composition produced by the farm. Herd health is also supported by good animal welfare.

2. Discussion

2.1 The Effect of Pasture Management on Milk Solid

Pasture based maintenance systems play a significant role in determining the quantity and quality of milk solids by providing high-quality forage that supports milk fat and protein synthesis. Paddock rotation management that ensures livestock graze during the vegetative phase with high energy and protein content has been shown to increase milk production and components. Re-

search shows that cows grazed on biologically managed pastures produce higher milk yields (1901.79 kg) compared to natural pastures (1634.04 kg), with higher fat content (3.76% vs. 3.63%), resulting in increased fat-corrected milk production (Ugorets *et al.*, 2021). Conversely, limitations in the quality and quantity of forage in conventional feeding systems correlate with lower milk production and less variation in composition (Mukasafari *et al.*, 2025). Effective pasture management not only improves nutrient utilization efficiency but also maintains the stability of milk solids production, as reflected in the average achievement of 379 kgMS per head in an optimally managed pasture-based system.

2.2 The Relationship between Nutrition and Body Condition Score on Milk Quality

Body Condition Score (BCS) reflects the balance between nutritional intake and energy requirements of dairy cows, making it an important indicator in evaluating milk quality. BCS stability indicates that feed management and grazing systems are able to maintain energy balance and prevent negative energy balance, which can reduce milk production and composition (Zhao *et al.*, 2019). Paddock rotation management and forage quality monitoring help maintain consistent nutrient supply, ensuring optimal body condition throughout the lactation period. An ideal BCS range is associated with more stable lipid metabolism and better formation of milk fat and protein components. Additionally, milk fatty acid profiles have been shown to reflect the nutritional status and metabolism of cows, making BCS stability an indicator of successful nutritional manage-

ment in supporting sustainable milk quality (Giannuzzi *et al.*, 2022).

2.3 The Role of Milking Hygiene on Milk Quality

Milking hygiene is a major determinant of the microbiological quality of milk, which is measured by Total Bacterial Count (TBC) and Somatic Cell Count (SCC) as indicators of udder quality and health. Various sources of contamination, such as the cleanliness of the barn, the body and udder of the cow, the milker's hands, milking equipment, and post-milking cooling procedures, contribute to an increase in TBC and SCC if not managed optimally (Mihajlović *et al.*, 2022). The systematic implementation of preventive and corrective measures, including udder sanitation before and after milking, milking machine hygiene, and storage temperature control, has been shown to significantly improve hygiene scores and reduce milk contamination levels (Mihajlović *et al.*, 2022). Quantitatively, the proportion of milk samples that met class I criteria based on TBC increased from 19.7% to 50.0% after hygiene procedures were improved (Mihajlović *et al.*, 2022).

2.4 The Effect of Pasture Management on Milk Solid

Livestock health, especially udder health, plays a central role in determining the composition and quality of dairy cow milk because the physiological condition of the udder directly affects the physical, chemical, and microbiological parameters of milk. According to Maharani and Risada (2025), milk quality is closely related to udder health and maintenance sanitation levels, where an increase in Somatic Cell Count (SCC) as an indicator of mastitis

correlates with a decrease in protein and fat content and changes in milk composition. Undetected subclinical mastitis can reduce total solids and non-fat solids (NFS), thereby impacting milk solid stability and the economic value of production. Additionally, good health management through routine monitoring, mastitis prevention, and the implementation of hygienic husbandry practices has been proven to support consistent milk quality and reduce the risk of microbial contamination. Daily health monitoring and optimal udder management not only maintain the efficiency of nutrient metabolism into milk components but also directly contribute to the sustainability of productivity and profitability in dairy farming (Maharani & Risada, 2025).

3. Practical Implication

This study confirms that the integration of pasture management, milking hygiene, and animal health plays a decisive role in optimizing milk quality and production efficiency in pasture-based dairy systems. Empirical findings from AJ Investment Dairy Farm demonstrate that a high level of feed self-sufficiency (93%) combined with controlled paddock rotation resulted in a total production of 219,827 kgMS, with an average of 379 kgMS per cow and 1,010 kgMS per hectare. These results indicate that well-managed pasture systems are capable of sustaining both productivity and milk solids consistency under large-scale operations. From a practical standpoint, several key implications can be derived for adaptation in the Indonesian context:

3.1 Land-Based Forage Optimization as the Foundation of Production Efficiency

The high contribution of on-farm feed (93%) highlights the importance of land as the primary production asset. The observed productivity (1,010 kgMS/ha) implies that optimizing land use through proper pasture establishment and soil fertility management can significantly reduce dependence on external feed inputs. Therefore, in Indonesia, the development of pasture-based systems should begin with land suitability assessment and the utilization of underused land resources to ensure adequate forage carrying capacity.

3.2 Nutritional Stability Reflected in Body Condition Score and Milk Solids

The consistency of milk solids production is closely associated with stable livestock condition, as indicated by Body Condition Scores maintained within the ideal range (4-6). This reflects a balanced energy-protein intake derived from high-quality forage and controlled supplementation. Practically, this implies that maintaining forage quality through rotational grazing and the integration of grasses and legumes is essential to support metabolic efficiency and sustain milk fat and protein synthesis.

3.3 Efficient Grazing Management to Maximize Nutrient Utilization

The implementation of paddock rotation after each milking ensures that cows consistently graze on forage in the vegetative phase, which has higher digestibility and nutrient content. This management strategy contributes directly to stable milk production and

composition. For Indonesia, adopting a controlled grazing system even at a cooperative or smallholder scale can improve feed efficiency and reduce variability in milk quality.

3.4 Hygiene Control Through Systematic Equipment Management and Filtration

Despite the absence of teat dipping, the farm maintained milk quality within safe microbiological limits through strict sanitation of milking equipment and the application of multi-stage filtration systems. This indicates that hygiene effectiveness is not solely dependent on a single practice, but rather on the consistency of the overall system. In practical terms, Indonesian dairy farms can improve milk quality by prioritizing routine sanitation protocols and simple but effective filtration technologies.

3.5 Preventive Animal Health Management to Ensure Production Stability

The low incidence of health disorders ($\pm 2\%$) and the implementation of strict segregation and milk disposal protocols for mastitis cases demonstrate the importance of preventive health management. This condition supports the stability of milk solids and overall production performance. Therefore, routine health monitoring, early detection of udder disorders, and strict quality control measures are critical to maintaining both milk safety and economic value.

The findings of this study suggest that the success of pasture-based dairy systems lies in the synergistic integration of land-based nutrition, controlled grazing, hygienic milking systems, and proactive animal health management.

For Indonesia, the adaptation of this model requires not only technical adjustments but also a systemic approach that aligns resource availability, farmer capacity, and management consistency. When implemented effectively, this integrated system has strong potential to improve milk quality, increase production efficiency, and reduce reliance on imported dairy products.

CONCLUSION

The findings of this study demonstrate that the integrated implementation of pasture management, milking hygiene, and animal health at AJ Investment Dairy Farm is effective in maintaining both milk quality and production stability. The application of a structured paddock rotation system supported by high forage self-sufficiency enables optimal nutrient intake, as reflected in milk solids production averaging 379 kgMS per cow and 1,010 kgMS per hectare. In addition, the stability of Body Condition Scores within the ideal range (4-6) and the low incidence of health disorders ($\pm 2\%$) indicate that nutritional balance and herd health are well maintained, contributing to consistent milk composition.

Moreover, disciplined hygiene practices through systematic equipment sanitation and filtration ensure that milk quality remains within safe microbiological standards. These results confirm that a well-integrated pasture based management system can simultaneously support productivity, product quality, and animal welfare. Therefore, this study reinforces the potential of such systems as a scientific reference for advancing sustainable and efficient dairy farming development in Indonesia.

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