

Diversification of Fresh Milk into Yogurt to Increase Economic Value of Dairy Groups

Widi Astuti, Catur Rini Widyastuti, Muhammad Rizky Fahrizal Putra, Ahmad Rickiyansyah Nurrahman, Fariq Hammam Firmansyah, Isnina Noor Ubay, Harianingsih Harianingsih*

Department of Chemical Engineering, Faculty of Engineering, Universitas Negeri Semarang, Semarang, Indonesia

*Corresponding Author: harianingsih@mail.unnes.ac.id

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Abstract. Low selling prices of fresh milk and the rejection of substandard milk by the Milk Processing Industry have reduced the income of dairy groups in Gunungpati, Semarang, and caused environmental problems due to milk disposal. This community service program aimed to increase the economic value of fresh milk through diversification into yogurt products. The program involved entrepreneurship motivation, assembly of a milk pasteurization unit, provision of a yogurt incubator, and hands-on yogurt production training for 20 members of a dairy processing group. The activity emphasized appropriate technology application and skill development to enable independent household-scale production. Results showed improved technical competence in yogurt processing, increased entrepreneurial motivation, and initial product trials for market testing. Fresh milk diversification into yogurt provides an alternative strategy to enhance income, reduce environmental waste, and strengthen community-based dairy business sustainability.

Keywords: fresh milk diversification; yogurt production; community empowerment; dairy business groups; appropriate technology

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INTRODUCTION

The dairy sector plays an important role in strengthening rural economies by providing continuous household income and supporting local food systems. In many parts of Central Java, dairy farming is conducted at a small scale, where households depend on one to three dairy cows as their primary livelihood source. Despite its economic relevance, the sustainability of small-scale dairy enterprises remains fragile due to structural constraints in pricing mechanisms, quality standards, and limited downstream processing capacity. These constraints restrict income growth and reduce the capacity of dairy households to improve their welfare (Mahler et al., 2022; Ozdikmenli Tepeli, 2023).

Village cooperatives (Koperasi Unit Desa/KUD) serve as intermediaries between dairy farmers and milk processing industries (Industri Pengolahan Susu/IPS). Fresh milk collected from farmers is distributed to processing industries outside the production area. However, milk prices are largely determined by processing industries, creating a market structure that limits farmers'

bargaining power. The disparity between selling prices and production costs significantly reduces profit margins. Feed expenses constitute the largest operational cost, while milk prices often remain below reasonable production value. This imbalance creates economic vulnerability among dairy households and weakens long-term business sustainability (Cheboi et al., 2024; Husnain et al., 2023).

Beyond welfare concerns, strict quality standards imposed by milk processing industries generate additional challenges. Milk that fails to meet specified parameters is rejected during quality testing. Rejected milk frequently cannot re-enter formal distribution channels and is discarded. This practice leads to environmental problems, including organic waste accumulation and unpleasant odors. From a sustainability perspective, such conditions represent inefficiency in resource utilization. Fresh milk is a perishable yet nutritionally valuable commodity; therefore, disposal without alternative processing reduces economic potential and creates environmental burdens (Jensen et al., 2022; Prasad & Kothari, 2022).

The limited capacity of dairy households to engage in product diversification further exacerbates the issue. Most farmers focus exclusively on raw milk production without applying processing technologies that could increase product value. Insufficient knowledge of fermentation techniques, packaging, and marketing restricts opportunities for value addition. Community empowerment requires not only production capability but also technological adaptation and entrepreneurial competence. Without structured intervention, dependency on raw milk sales will continue to expose farmers to market price volatility and quality rejection risks (Jensen et al., 2022; Prasad & Kothari, 2022).

Milk diversification into processed dairy products offers a strategic solution to address these interconnected problems. Yogurt production extends shelf life, enhances product stability, and increases market attractiveness. Through controlled fermentation, lactose is converted into lactic acid, producing a functional food with probiotic benefits and improved digestibility. From an economic standpoint, yogurt commands a higher market price than fresh milk, enabling producers to capture greater value within the supply chain. Diversification therefore functions as both a technological and economic intervention (Geinoro et al., 2025; Upreti et al., 2025).

Previous community service initiatives have shown that yogurt-making training can improve knowledge and stimulate entrepreneurial interest. However, many programs focus predominantly on technical demonstrations without integrating structured entrepreneurship motivation, appropriate equipment support, and post-training assistance. The absence of a comprehensive empowerment model limits sustainability and reduces the long-term impact of community service activities. A more integrated approach that combines technology transfer, business mindset development, and market orientation is necessary to ensure effective implementation (Hosseini Sabeghi et al., 2024; Qiu et al., 2020).

In Patemon Village, Gunungpati District, Semarang City, Indonesia, the Mentari dairy processing group represents a community-based organization composed largely of family members of dairy farmers. The group faces recurring challenges related to low milk prices, quality rejection, and limited product innovation. Although milk production potential is available, downstream processing activities remain underdeveloped. This condition indicates an untapped opportunity for value-added

diversification through appropriate technological intervention and entrepreneurship strengthening.

The challenges identified in this context can be categorized into three interconnected aspects: economic vulnerability due to low milk prices, environmental impact resulting from milk disposal, and limited technological and entrepreneurial capacity. Addressing these aspects separately would not generate sustainable outcomes. An integrated empowerment strategy that transforms fresh milk into higher-value products while enhancing technical competence and business orientation becomes essential.

From a broader development perspective, milk diversification into yogurt aligns with the Sustainable Development Goals (SDGs). The activity supports SDG 8 (Decent Work and Economic Growth) by strengthening household-scale enterprises and promoting productive economic activities. It also contributes to SDG 12 (Responsible Consumption and Production) by reducing food waste and encouraging efficient resource utilization. By converting rejected or lower-grade milk into value-added products, the intervention promotes circular economic principles and minimizes environmental impact.

Despite the recognized benefits of dairy product diversification, there remains a practical gap between theoretical empowerment models and implementation at the grassroots level. Many dairy communities lack access to appropriate technology, structured training, and mentoring that integrates technical, economic, and environmental considerations. This gap highlights the need for higher education institutions to play an active role in facilitating applied technology transfer and sustainable community engagement (Pangestu et al., 2023; Weissgerber & Hess, 2022).

Based on these considerations, the objective of this community service activity was to enhance the economic value of fresh milk through yogurt diversification among members of the Mentari dairy processing group. The program aimed to provide practical training in pasteurization and fermentation processes, supply essential production equipment, strengthen entrepreneurial motivation, and promote household-scale business development. Through an integrated empowerment model, the activity sought to increase technical competence, encourage independent enterprise formation, reduce environmental waste, and improve the sustainability of local dairy businesses.

By repositioning fresh milk from a vulnerable raw commodity into a diversified value-added product, yogurt production offers a viable pathway to strengthen rural economic resilience. This initiative demonstrates how technology-based community service can optimize local resources, promote sustainable production practices, and create long-term socioeconomic benefits for dairy households.

METHODS

The community service program was implemented over an eight-month period from March to October 2024 in Patemon Village, Gunungpati District, Semarang. The primary partners involved in this activity were 20 members of the Mentari dairy processing group, most of whom were family members of dairy farmers. The program applied an integrated empowerment approach combining situation analysis, entrepreneurship strengthening, appropriate technology transfer, and hands-on production training to support the diversification of fresh milk into yogurt. The implementation design was structured to ensure that technical intervention was accompanied by capacity building and sustainability considerations.

The initial stage involved a preliminary survey conducted in January 2024 to identify the economic, environmental, and technical constraints faced by the dairy group. Data were collected through direct observation, informal interviews, and group discussions with members and cooperative representatives. The survey revealed recurring issues related to low milk prices, quality rejection by milk processing industries, disposal of unsold milk, and limited knowledge of downstream processing techniques. The results of this assessment were used to design an intervention model that was contextually relevant and aligned with local needs.

Following the survey, a program socialization session was organized to introduce the objectives, scope, and expected outcomes of the yogurt diversification initiative. During this session, participants received information about the economic potential of yogurt production, production stages, equipment requirements, and activity timelines. Interactive discussions were facilitated to encourage active participation and collective commitment. This phase aimed to ensure that participants clearly understood the benefits and responsibilities associated with the program before entering the technical

implementation stage.

Entrepreneurship motivation was integrated as a critical component of the empowerment process. The session emphasized business awareness, innovation capacity, and the importance of value-added product development. Participants were encouraged to shift their perspective from solely producing raw milk to recognizing opportunities for processed dairy products with higher market value. Discussions included small-scale marketing strategies, pricing considerations, and household-level business feasibility. This stage aimed to strengthen entrepreneurial attitudes and build confidence in developing independent yogurt production activities.

To support sustainable production, appropriate processing technology was introduced through the assembly and handover of a milk pasteurization unit and a yogurt incubator. The pasteurization unit had a capacity of 5 liters and was constructed from 3 mm stainless steel equipped with a thermostat to maintain controlled heating. The yogurt incubator had a capacity of 20 liters and was designed to maintain fermentation temperatures between 40–45°C using temperature control mechanisms. The equipment was intentionally designed to be durable, simple to operate, and suitable for household-scale production. Technical demonstrations were conducted to ensure participants understood safe operation procedures and temperature control principles.

Practical yogurt production training constituted the core technical component of the program. The training covered milk filtration, pasteurization, cooling, inoculation with starter culture, fermentation, flavor addition, packaging, and cold storage. Fresh milk was filtered to remove impurities before being heated during pasteurization. After cooling to fermentation temperature, yogurt starter culture was added, and the mixture was incubated under controlled conditions for 5–8 hours. Upon completion of fermentation, sugar and flavoring were incorporated according to consumer preferences, followed by packaging and refrigeration. Participants were directly involved in each production stage under supervision to ensure technical competence and process understanding.

The level of program achievement was measured using several indicators, including full participation of targeted members, increased knowledge of yogurt production processes, ability to operate pasteurization and incubation equipment independently, successful production

Table 1. Solution Offered

No	Aspect	Problem	Solution	Assets given to partners
1.	Welfare	The current price of milk from farmers is only around Rp 2,700 to Rp 2,900 per liter, whereas a fair price would be Rp 3,500 per liter. This price does not cover the daily feed costs of Rp 25,000, meaning that farmers' basic needs are not fully met.	The application of science and technology to produce processed dairy products such as yogurt with higher selling value.	Yogurt-making equipment in the form of a milk pasteurization pot with an estimated price
2.	Environment	Milk that does not meet IPS standards is dumped into the environment and produces an unpleasant odor that disturbs the surrounding area.	Utilizing technology in the yogurt production process to improve efficiency, quality, and innovation.	Yogurt-making equipment in the form of a yogurt incubator with an estimated price
3.	Education	Low public knowledge and awareness regarding independent entrepreneurship by utilizing cow's milk to make yogurt.	Transfer information and knowledge through motivation and training in yogurt production from the initial process to the final product, with the aim of improving skills and knowledge in making high-quality yogurt and optimizing the added value of the product.	Motivation for self-employment and yogurt-making training.

of yogurt prototypes with acceptable sensory characteristics, and expressed willingness to initiate household-scale yogurt businesses. Monitoring and mentoring activities were conducted after training sessions to evaluate production consistency and participant confidence. Through this integrated methodological approach, the program aimed to establish a sustainable foundation for fresh milk diversification into yogurt as a strategy to enhance economic value and reduce environmental waste.

RESULTS AND DISCUSSION

Identification of Core Problems in Dairy Processing Groups

The initial stage of implementation revealed that the challenges faced by the Mentari dairy processing group were multidimensional, encompassing economic, environmental, and capacity-related aspects. Figure 1 illustrates the early observation and problem identification

Table 2. Solutions and Achievements Target for Each Aspect of the Problem

No.	Aspect	Solution	Achievements Target
1.	Welfare	The use of science and technology to produce yogurt with higher selling value	Milk pasteurization pot
2.	Environment	The application of technology in utilizing milk that is below IPS standards by making yogurt products	Yogurt incubator
3.	Education	Providing motivation and training in yogurt production from the initial process to the finished yogurt product	Yogurt making training

process conducted through participatory discussion with group members in Patemon Village. Direct engagement allowed the service team to capture contextual realities beyond numerical data, including household dependency on raw milk sales and vulnerability to fluctuating prices.



Figure 1. The Volunteers Observed the Problems Faced by The Cow Milk Processing Group in Patemon Village

From an economic perspective, the selling price of fresh milk determined by milk processing industries remained significantly below reasonable production value. As summarized in Table 1, farmers received approximately Rp 2.700–Rp 2.900 per liter, while estimated fair pricing should reach Rp 3.500 per liter to balance feed costs and operational expenses. Feed expenditures, which averaged Rp 25.000 per cow per day, reduced profit margins to minimal levels. This condition confirmed structural inefficiency in the dairy supply chain and justified the need for value-added intervention.

Environmental challenges were equally pressing. Milk that failed to meet IPS quality standards was rejected and frequently disposed of, leading to unpleasant odors and organic waste accumulation. Such disposal practices reflect inefficient resource utilization and contradict principles of sustainable production. Table 1 categorizes this issue under environmental aspects, emphasizing the need for technological intervention to prevent waste and extend product usability.

Educational and capacity-related problems were also identified. Limited knowledge of fermentation technology and lack of entrepreneurial orientation restricted diversification opportunities. Table 1 highlights this aspect by identifying low awareness of independent entrepreneurship as a core constraint. These findings collectively demonstrate that economic vulnerability, environmental inefficiency, and limited technical capacity were interconnected challenges requiring integrated intervention.

Integrated Solution Framework

The solutions implemented were structured to address the three identified aspects simultaneously. As presented in Table 2, each aspect was paired with a targeted intervention and measurable achievement indicators. Welfare-related issues were addressed through the introduction of milk pasteurization equipment to enable higher-value yogurt production. Environmental concerns were mitigated through the provision of a yogurt incubator designed to process substandard milk into marketable

Table 3. Results of Yogurt Making Training

Indicator	Description	Plan/ Target	Actual
Goal	Total Participants	20 people	20 people
	Community	Pengging village cow milk processing business group	Pengging village cow milk processing business group
	Participant Gender	10 men 10 women	1 man 19 women
	Growth in the productivity of home-based yogurt industries	Positive response and willingness to develop yogurt products	New trial production of home-industry yogurt
	Entrepreneurship motivation	Understanding the objectives of yogurt production entrepreneurship	Participants understand and are motivated to start a yogurt business
Output	Yogurt making training	Technology transfer on how to process cow's milk into yogurt	Participants understand the purpose and method of yogurt production

products. Educational limitations were tackled through structured motivation sessions and hands-on training.

This integrated framework reflects an applied empowerment model rather than isolated technical assistance. By combining appropriate technology provision with skill development and entrepreneurship reinforcement, the intervention sought to create sustainable behavioral change rather than temporary production activity.

Community Engagement and Participatory Implementation

Figure 1 demonstrates that the problem identification process was conducted through interactive group discussions rather than top-down assessment. Participants actively expressed concerns regarding declining income and milk rejection. Such participatory engagement strengthened program relevance and enhanced acceptance during subsequent implementation stages.

Figure 2 visually represents the structured stages of the community service methodology, beginning with survey and socialization, followed by motivation sessions, equipment assembly, and yogurt production training. This sequential design ensured that technological intervention was preceded by cognitive readiness and collective agreement. The structured flow minimized resistance and improved adoption outcomes.

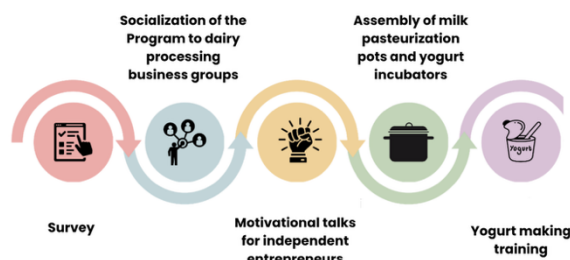


Figure 2. Methods of Community Service Activities

Entrepreneurship Strengthening and Behavioral Change

Entrepreneurial motivation sessions generated positive behavioral responses among participants. Many participants initially perceived milk solely as a raw commodity dependent on IPS pricing. After motivational discussions, participants began to recognize diversification potential and market opportunities for processed dairy products. Table 3 indicates full attendance of 20 participants, demonstrating strong engagement.

Gender participation data in Table 3 show a predominance of female participants (19 women and 1 man), reflecting the household-based nature of dairy processing activities. This distribution highlights the role of women in microenterprise development and aligns with inclusive economic empowerment objectives.

The motivational stage contributed to increased confidence and willingness to initiate

small-scale yogurt production. Participants demonstrated openness to experimentation and collaboration, indicating a shift in entrepreneurial mindset.

Technical Implementation of Yogurt Production

The core technical outcome involved successful yogurt production using controlled fermentation processes. Participants practiced milk filtration, pasteurization, starter inoculation, incubation, and packaging under supervision. Temperature control during pasteurization and incubation was emphasized to ensure product consistency and safety.

Figure 3 presents the various yogurt flavors produced during training, including strawberry, lychee, grape, and plain variants. The diversification of flavors was intentionally aligned with consumer preferences to increase market attractiveness. Flavor variation also demonstrated participants' capacity to adapt products according to demand trends.



Figure 3. Various Flavors of Yogurt Produced During Training

The yogurt produced during training exhibited acceptable texture, aroma, and taste characteristics. The absence of preservatives ensured product safety while emphasizing hygienic production practices. The fermentation process enhanced shelf life compared to raw milk, confirming value addition through diversification.

Technology Transfer and Equipment Utilization

The introduction of appropriate processing technology represented a significant milestone. Figure 4 displays the yogurt incubator provided to the group. Constructed from stainless steel with controlled temperature mechanisms, the incubator

enabled stable fermentation at 40–45°C. The pasteurization unit ensured safe heating conditions and minimized contamination risks.



Figure 4. Yogurt Incubator

Equipment provision addressed both welfare and environmental aspects simultaneously. Substandard milk that would otherwise be discarded could now be processed into yogurt, reducing waste while generating additional income streams. The technological design prioritized simplicity and durability to ensure long-term usability within household settings.

Training emphasized independent operation of equipment. Participants demonstrated the ability to manage heating duration, monitor fermentation temperature, and maintain hygiene standards without external assistance. This competence confirmed successful technology transfer.

Assistance and Mentoring Process

Beyond initial training, continuous mentoring played a critical role in strengthening implementation outcomes. Figure 5 illustrates assistance provided during production, packaging, and process monitoring stages. Mentoring ensured accurate ingredient measurement, consistent fermentation timing, and attractive packaging design.



Figure 5. Assistance to Partners

Packaging improvement increased perceived product value and market readiness. Participants were introduced to labeling considerations and

presentation strategies to enhance competitiveness. Monitoring activities confirmed participants' growing independence and production confidence.

The mentoring approach also reinforced peer-to-peer learning. Participants who quickly mastered techniques supported others, creating internal knowledge diffusion within the group. This dynamic strengthened collective capacity and reduced dependency on external facilitators.

Market Testing and Early Commercialization

Market linkage activities constituted an essential component of sustainability. Figure 6 depicts yogurt placement in retail stores equipped with beverage coolers and participation in local expos organized by the Central Java Trade and Industry Office. These initiatives provided real market exposure and consumer feedback.

Initial market testing demonstrated positive consumer response to flavor variety and packaging presentation. Although production scale remained limited during the early stage, participants expressed readiness to increase output based on demand potential. Market exposure also enhanced participants' confidence and reinforced the economic feasibility of yogurt diversification.



Figure 6. Marketing Assistance for Yogurt in Stores

The ability to enter retail channels indicates that the intervention moved beyond training

simulation toward practical commercialization. Such progression reflects meaningful empowerment rather than symbolic activity.

Evaluation of Program Indicators

Table 3 summarizes achievement indicators. All targeted participants attended training sessions, fulfilling quantitative participation goals. Qualitative indicators, including increased understanding of production processes and willingness to initiate business activities, were also achieved.

New trial production at household scale emerged as a tangible output. Although long-term income increase requires further monitoring, initial production continuity demonstrates behavioral change and technical competence acquisition.

The intervention addressed the three primary aspects identified earlier. Economically, yogurt production created opportunities for higher selling prices compared to raw milk. Environmentally, milk that previously risked disposal was transformed into consumable products. Educationally, participants gained knowledge and entrepreneurial awareness.

Alignment with Sustainable Development Goals

The program contributes to SDG 8 (Decent Work and Economic Growth) by strengthening microenterprise capacity within rural households. It also supports SDG 12 (Responsible Consumption and Production) by minimizing milk waste and promoting resource efficiency. Through appropriate technology adoption and local resource optimization, the initiative reflects sustainable production principles. Furthermore, the prominent involvement of women aligns with inclusive economic empowerment objectives and enhances social sustainability within the community.

Strengths, Limitations, and Future Development

One major strength of the program lies in its integrated approach combining technology provision, skill training, motivation, and market linkage. The participatory implementation method enhanced acceptance and sustainability. Equipment design suited household-scale production, increasing feasibility.

However, limitations remain. Production capacity is currently limited by available raw milk volume and refrigeration facilities. Long-term

income impact requires continued monitoring. Access to broader distribution networks and branding development may further enhance economic outcomes.

Future development should focus on scaling production, establishing cooperative branding, strengthening quality assurance standards, and expanding digital marketing strategies. Continuous mentoring and financial literacy training may further improve sustainability.

The diversification of fresh milk into yogurt successfully transformed a structural vulnerability into an opportunity for value addition. The integration of Figures 1–6 and Tables 1–3 demonstrates that the intervention moved systematically from problem identification to solution implementation, capacity strengthening, and early commercialization.

The fresh milk diversification through yogurt production represents a feasible strategy to enhance economic value, reduce environmental waste, and strengthen community-based dairy enterprises. The intervention model may serve as a replicable framework for similar rural dairy communities facing pricing and quality rejection challenges.

CONCLUSION

Diversification of fresh milk into yogurt proved to be an effective strategy to address economic, environmental, and capacity-related challenges faced by the Mentari dairy processing group in Gunungpati, Semarang. The integrated intervention combining entrepreneurship motivation, appropriate technology provision, and hands-on fermentation training successfully improved participants' technical competence and strengthened readiness to initiate household-scale yogurt production. The program reduced the risk of milk disposal by transforming substandard fresh milk into value-added products with extended shelf life and market appeal. Early market testing demonstrated positive consumer acceptance, indicating potential for income enhancement. The strength of the program lies in its participatory approach and sustainable technology transfer model; however, production scale and long-term income impact require continued mentoring and market expansion strategies. Future development should focus on increasing production capacity, strengthening branding and distribution networks, and ensuring consistent quality control to support sustainable community-based dairy enterprises.

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