

Redesigning a Circular Business Model Canvas (CBMC) for smallholder dairy farming: Financial feasibility and SDG alignment in Sarangan, Indonesia

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Abstract.

The Indonesian government has committed to implementing a circular economy, as outlined in its national roadmap to 2025. This study aims to redesign a Circular Business Model Canvas (CBMC) for smallholder dairy farming in Sarangan, Magetan, to enhance farmers' income and welfare while promoting environmental sustainability. An exploratory mixed-methods design was employed, combining thematic analysis and expert judgment with financial feasibility assessment using the Benefit–Cost (B/C) ratio. The redesigned CBMC incorporates circular economy principles into dairy operations, emphasizing eco-conscious value propositions, diversified revenue streams, and multi-stakeholder partnerships. The results show that cheese processing, yogurt production, and the tourism café are financially viable under normal ($B/C \approx 2.4\text{--}2.5$) and peak demand ($B/C > 6$) conditions but not under low-demand conditions ($B/C < 1$). The model also contributes significantly to the Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth, 85%), SDG 6 (Clean Water and Sanitation, 80%), and SDG 7 (Affordable and Clean Energy, 75%), with lower contributions to SDG 12 (70%) and SDG 15 (60%). Key challenges include farmer resistance to adopting new practices, limited access to capital, and seasonal fluctuations in demand. The study addresses these barriers and offers strategies to ensure scalability. Overall, this research fills a gap in the application of circular business models in agrifood systems by integrating business model redesign, financial feasibility, and SDG mapping, providing a replicable framework for smallholder dairy–ecotourism communities in developing regions.

Keywords: *Circular business model canvas, Dairy farming, Financial feasibility, Sustainable development goals.*

JEL Classification: Q13, Q56, M21, O13

INTRODUCTION

Magetan Regency, located at the western tip of East Java Province, is one of the potential agribusiness centers in the Mataraman region, particularly in the dairy farming

subsector. According to data from the Central Bureau of Statistics (BPS) of Magetan Regency, during the 2018–2023 period, the distribution of the dairy cattle population across several districts showed a significant upward trend in certain areas (BPS Kabupaten Magetan, 2024a, 2024b). The dairy farming subsector plays an important role in supporting national food security through the supply of fresh milk, while also contributing to the achievement of the Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger), Goal 8 (Decent Work and Economic Growth), and Goal 12 (Responsible Consumption and Production).

Table 1. Dairy cattle population by district in Magetan Regency, 2018 and 2023 (head)

District	2018	2023
Poncol	-	20
Lembeyan	-	4
Kawedanan	-	7
Magetan	-	4
Ngariboyo	-	5
Plaosan	161	565
Sidorejo	19	70
Panekan	92	70
Sukomoro	41	28
Bendo	-	3
Maospati	-	33
Karas	11	20
Total	324	829

Source: Central Bureau of Statistics (BPS) of Magetan Regency, 2024

Out of the 18 districts in Magetan Regency, 12 have recorded dairy cattle populations. Plaosan District shows the most significant increase, rising from 161 heads in 2018 to 565 heads in 2023. Within this district lies Sarangan Village, which is well-known as a tourist destination and also as the location of the Kampung Susu Lawu (KSL) community of smallholder dairy farmers, the focus of this study.

Despite its considerable potential, the KSL farming community faces various structural challenges. Waste management remains suboptimal, as most livestock manure is still discharged directly into waterways without treatment, leading to pollution and health risks (Dziuba et al., 2021). Limited business capital and lack of access to technical training also present major obstacles (Salimi, 2023). Conventional production patterns, inefficient feed management, and dependence on forage feed cause fluctuations in milk production across seasons—abundant during the rainy season but declining in the dry season—which directly affect farmers’ incomes (Horvath et al., 2018; Rodias et al., 2020). These conditions not only reduce farmers’ annual income potential by tens of millions of rupiah but also increase the burden of water pollution in upstream areas, which may affect both the ecosystem quality and public health in the Sarangan tourism area.

Sarangan’s geographical position as a strategic tourist destination in the Mount Lawu area presents a significant opportunity to develop an integrated livestock model based on ecotourism and the circular economy. This approach aligns with the concept of sociopreneurship, which emphasizes community-based enterprises with social, economic, and environmental sustainability (Cheruiyot & Venter, 2024; Flores Anaya et

al., 2023; Hillman et al., 2018). The utilization of livestock waste into derivative products—such as organic fertilizer, biogas, compost, and educational souvenirs—can generate new streams of income for the community (Chanthes et al., 2024).

Figure 1 presents the circular value chain framework, which is particularly relevant for application in livestock–ecotourism ecosystems such as KSL.

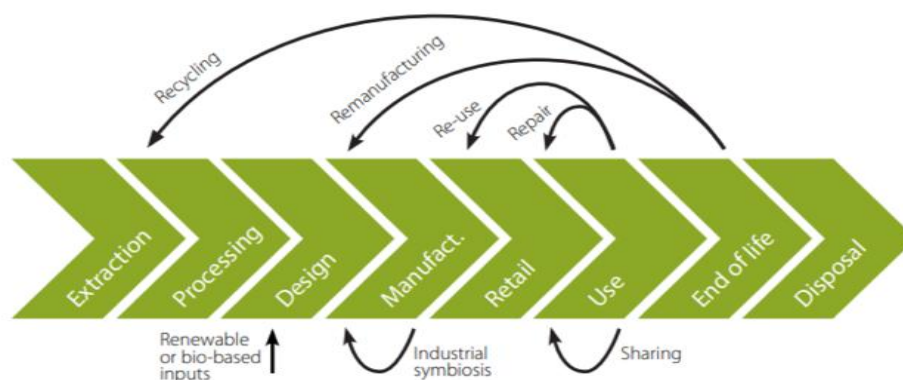


Figure 1. Circular Value Chain Framework for Livestock–Ecotourism Systems

Source: adapted from Lacy & Rutqvist (2015)

Circular economy literature emphasizes the importance of the waste-to-resource principle in dairy agribusiness, including the processing of waste into organic fertilizer or alternative energy (biogas) to reduce dependence on fossil fuels and chemical fertilizers. However, its implementation at the community level is often partial and not yet framed within a comprehensive business model. Studies on dairy farming largely emphasize technical or managerial aspects, such as waste treatment and the feasibility of biogas units—for instance, the environmental–economic analysis of digesters in Italy (Torquati et al., 2014)—but do not redesign community business models in an integrated manner, let alone link them with the SDGs.

On the other hand, the literature on circular business models has mostly focused on tool development and model experimentation (Bocken et al., 2021; Boldrini & Antheaume, 2021), without integrated testing in the context of smallholder farming or ecotourism, and without mapping contributions to the SDGs. Research in the agrifood sector reveals varying levels of circular practice maturity, with most approaches remaining at the conceptual level and failing to integrate economic, environmental, and social dimensions at the operational level (Barth et al., 2017; Scandurra et al., 2023). Even the Triple Layered Business Model Canvas (TLBMC), which has begun to be applied in the agrifood sector, primarily expands the sustainability dimensions but does not explicitly link business model design to SDG targets or analyze the financial implications of new revenue streams (Joyce & Paquin, 2016). Meanwhile, dairy farming case studies that apply circular economy practices through anaerobic digestion indeed show potential for income diversification; however, the focus remains on the technical performance of digesters and market incentives, rather than on redesigning community business models connected to the SDGs (Herbstritt et al., 2023).

Based on this review, a research gap emerges. There is still no study that simultaneously integrates the redesign of the Circular Business Model Canvas (CBMC), financial feasibility analysis, and mapping of contributions to the SDGs within the context of smallholder dairy farming communities and ecotourism.

The novelty of this study lies in three main aspects. First, conducting an integrated redesign of the CBMC, rather than a mere conceptual adaptation. Second, assessing the

financial feasibility of new revenue streams using the Benefit–Cost (B/C) ratio, which is still rarely applied in circular business model studies. Third, explicitly mapping CBMC activities to five relevant SDGs (SDG 6, 7, 8, 12, and 15). The integration of these three aspects differentiates this research from previous studies and strengthens both its theoretical and practical contributions. In addition, the proposed model serves as an applied framework that can be replicated in other smallholder dairy–ecotourism communities in mountainous areas with similar characteristics.

Accordingly, this study aims to: (i) redesign the CBMC for KSL based on expert judgment; (ii) evaluate the feasibility of new revenue streams through benefit–cost analysis; and (iii) assess the contribution of CBMC implementation to sustainability dimensions, covering environmental and social aspects, and their relevance to the Sustainable Development Goals (SDGs), particularly SDG 6, 7, 8, 12, and 15.

METHODS

Research design

This study employed a mixed-methods design with an exploratory qualitative dominance enriched by quantitative analysis. The qualitative approach was conducted through thematic analysis and the integration of expert judgment in redesigning the CBMC. The quantitative approach was applied through financial analysis using the Benefit–Cost (B/C) ratio. This combination was chosen to capture the socio-contextual dimensions while simultaneously assessing the economic feasibility of the developed business model.

Research location and subjects

The study was carried out in Kampung Susu Lawu, Sarangan, Magetan Regency, East Java, from January to December 2024. This location was selected due to its strategic relevance for developing dairy farming, the presence of a nascent dairy processing industry, and its potential for ecotourism.

The research subjects consisted of two groups:

1. Local actors include dairy farmers and cooperative managers who are directly involved in milk production and processing.
2. Experts: Six individuals were selected purposively, with a minimum of five years of professional experience, comprising two academics in livestock and sustainable agribusiness, two cooperative/dairy processing practitioners, and two technical officers from the Department of Animal Husbandry and Animal Health of Magetan Regency. This number was considered sufficient to obtain in-depth insights while maintaining validation focus.

Research procedures

The research process consisted of six main steps:

1. Developing the existing Business Model Canvas (BMC) based on the actual conditions of dairy farming.
2. Identifying the Value Proposition Canvas (VPC) to clarify customer segments, needs, and value offered.
3. Designing the initial CBMC draft that integrates sustainability aspects.
4. Conducting semi-structured interviews with experts to validate and enrich each CBMC block.
5. Identifying opportunities for product diversification (e.g., cheese, yogurt, biogas) through thematic analysis.

6. Assessing the financial feasibility of new business ventures using the B/C ratio.

Data collection

Data collection was carried out in two stages of interviews. The first stage involved in-depth interviews with local actors to gain an understanding of the actual conditions, challenges, and opportunities for developing a circular business model. The second stage involved semi-structured interviews with experts, including academics, practitioners, and technical officers. The interview guide was developed based on CBMC elements (Beaver et al., 2021; Johnson et al., 2018), covering value proposition, customer segments, distribution channels, customer relationships, revenue streams, key resources, key activities, key partners, and cost structure. Exploratory topics included business challenges, waste utilization strategies such as biogas and organic fertilizer, opportunities for product diversification into cheese, yogurt, and other processed milk products, and community-based marketing strategies. The guide was internally validated and consistently applied across both stages of interviews.

Data analysis

Interview transcripts were analyzed through open coding and subsequently grouped into main themes corresponding to CBMC blocks (Niero et al., 2021). Methodological triangulation was employed by comparing results from local actors and experts, and this was further confirmed through field observations and secondary documentation. Expert inputs were then mapped into the CBMC matrix and refined iteratively. The process concluded with a validation workshop to ensure sustainability, feasibility of implementation, and relevance of the model to actual conditions in Sarangan.

Mapping to the SDGs

The redesigned CBMC was mapped against the SDGs, referring to the official UN framework and sectoral indicators relevant to livestock and ecotourism (United Nations, 2020). Activities in the CBMC were aligned with the targets of SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land).

Financial feasibility analysis

The feasibility study employed Benefit–Cost (B/C) ratio analysis to evaluate the prospects of new ventures at KSL. The analysis covered a five-year projection, with 2019–2023 as historical data and 2024–2028 as the projection period. Revenue assumptions were based on production capacity and estimated tourist visits obtained from secondary data and interviews with managers.

Key parameters included:

1. Initial investment: cheese production equipment (IDR 8,590,000) and construction of a tourism café (IDR 110,000,000).
2. Revenue scenarios: low, normal, and high, adjusted to production capacity and seasonal demand fluctuations.
3. Financial parameters: risk-free discount rate of 5.5% (government bonds FR0046) and average inflation of 3.2% (2019–2023).
4. Calculation: Net Cash Flow (NCF) was calculated as gross revenue minus operating costs; Discounted Cash Flow (DCF) was calculated using the formula $DCF = NCF / (1 + r)^t$.

5. Feasibility criteria: Businesses were considered feasible if the benefit-to-cost ratio (B/C ratio) was greater than 1, indicating that the benefits outweighed the costs.

The B/C method was chosen for its simplicity, appropriateness for community-scale enterprises, and frequent use in agribusiness feasibility studies.

RESULTS AND DISCUSSION

Result

This section presents the key findings of the study regarding the implementation of the redesigned CBMC at KSL. The results are organized into several parts, beginning with the main challenges encountered in applying the CBMC within the local dairy farming ecosystem. This is followed by a description of the redesigned business model, which incorporates circular economy principles into production and waste management practices. The subsequent subsections report the financial feasibility of new revenue streams and the environmental and social impacts arising from the model's implementation. Together, these findings provide a comprehensive understanding of how CBMC can enhance the economic viability, environmental sustainability, and social empowerment of smallholder dairy and ecotourism communities.

Challenges in implementing the CBMC at KSL

The implementation of the redesigned CBMC at KSL faces several challenges that reflect social, economic, and institutional barriers within the local dairy farming ecosystem. The distribution of these challenges is presented in Figure 1.

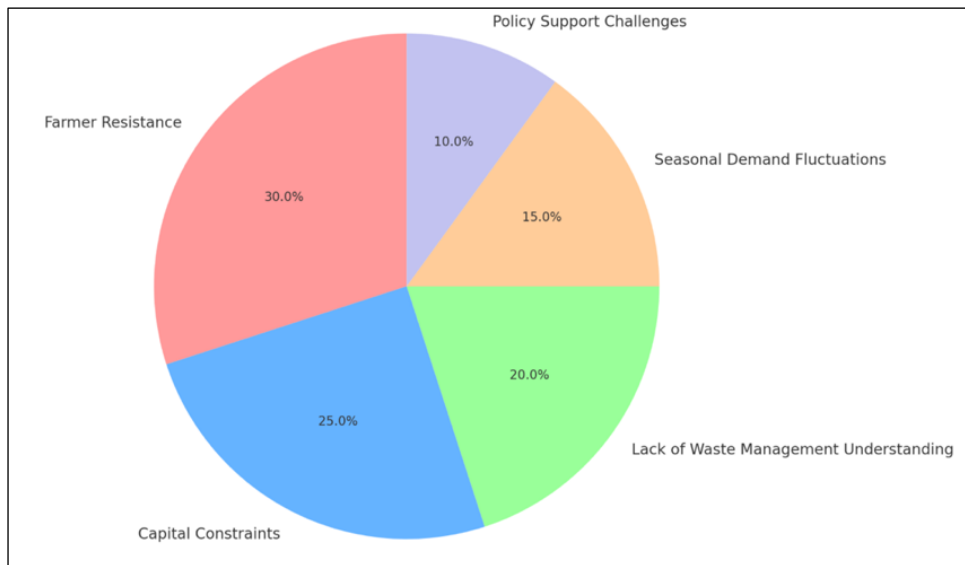


Figure 1. Challenges in implementing the CBMC at KSL

The most significant barrier is farmer resistance (30%), characterized by a strong attachment to traditional practices and reluctance to adopt new methods in both production and waste management. The second major challenge is limited capital (25%), referring to difficulties in accessing financing for environmentally friendly technologies, production equipment, or supply chain improvements. Furthermore, lack of knowledge about waste management (20%) remains a critical obstacle, as livestock waste with potential for processing is often still discharged directly into waterways.

Seasonal demand fluctuations (15%) also create constraints in production planning and cash flow management, since milk demand increases during holiday seasons but

drops sharply at other times. The final challenge is limited policy support (10%), marked by the absence of specific regulations or local-level incentives to encourage the adoption of circular economy practices in the dairy farming sector.

Overall, these challenges indicate that the success of CBMC implementation at KSL is determined not only by the quality of the business model design but also by social factors, resource availability, market dynamics, and institutional support.

Redesign of the CBMC at KSL

The redesigned CBMC at KSL represents an integrated business model that combines environmental, economic, and social aspects. The redesign was based on field observations, in-depth interviews, focus group discussions (FGDs), and expert input from specialists in livestock, agribusiness, and environmental management.

To illustrate the upstream–downstream linkages, Figure 2 presents the circular economy process flow scheme at KSL. This scheme shows the connections between milk production, waste management, by-product utilization, and derivative product creation.

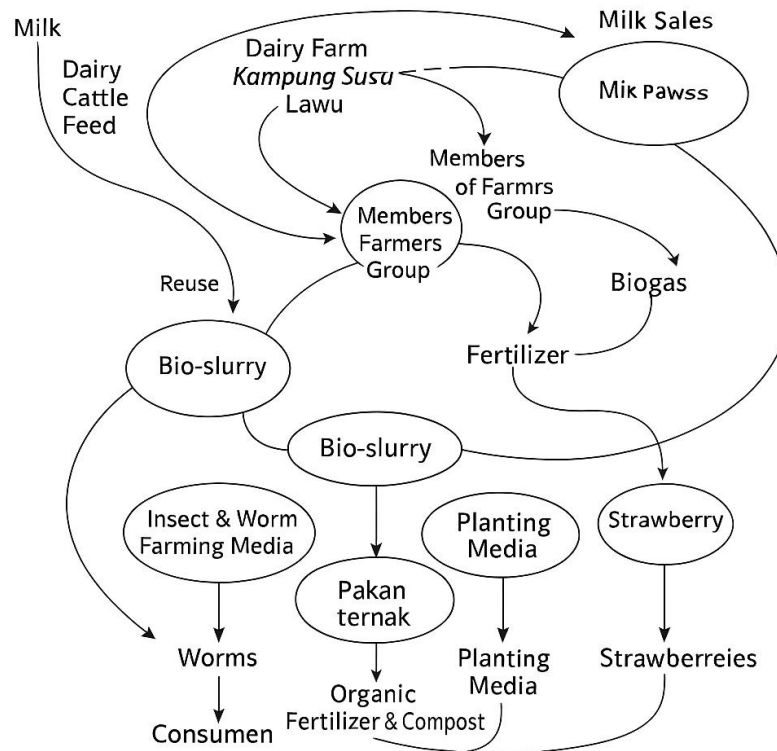


Figure 2. Circular economy process flow at KSL (upstream–downstream diagram integrating CE and take-back system)

The process begins with feeding dairy cattle, which produce fresh milk as the main product. Milk is either sold directly to consumers through KSL or distributed to dairy processing industries (DPIs) for processing into derivative products, such as cheese and yogurt.

Non-organic waste, such as plastic feed bags, is collected for reuse, while organic waste is fermented in a biogas unit to produce methane gas and bio-slurry. The bio-slurry is subsequently applied to a wide range of productive activities, including earthworm cultivation for fish and poultry feed, black soldier fly farming as livestock feed, oyster

mushroom cultivation, strawberry cultivation, supplementary feed for dairy cattle, as well as organic fertilizer and compost for agriculture.

All these cultivation products are then sold back to the market, creating additional income streams while reducing waste.

To map the overall business strategy, Figure 3 displays the redesigned CBMC, which includes nine standard Business Model Canvas blocks, as well as two additional blocks: the Take-back System and Adaptation Factors.

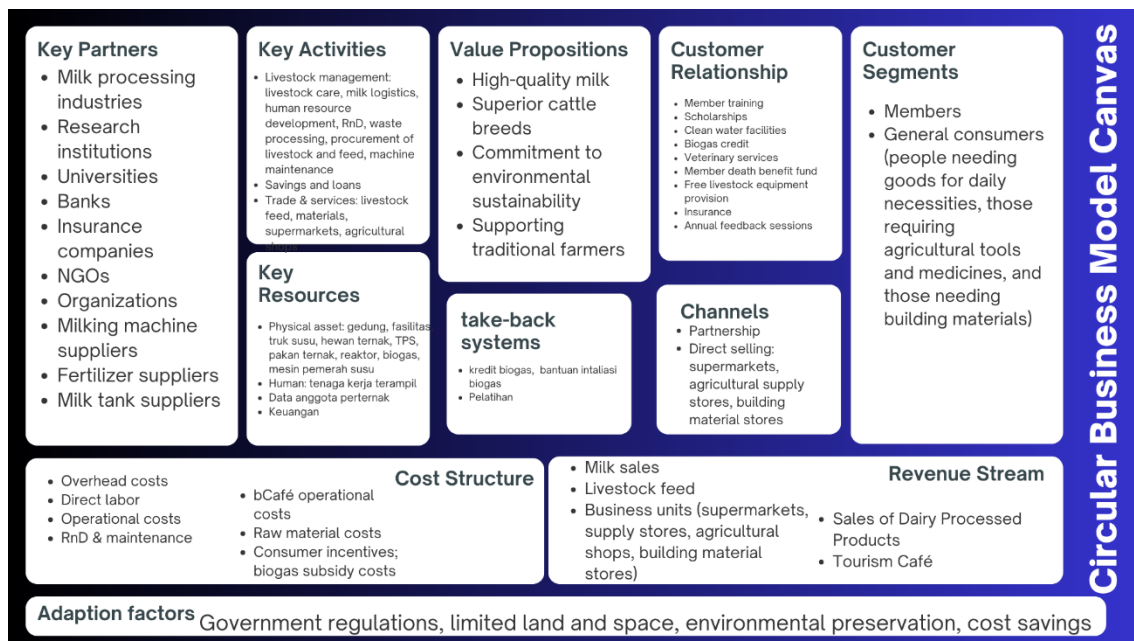


Figure 3. Redesigned SBMC for KSL (9+2 block canvas diagram)

The redesigned CBMC offers a value proposition that includes providing fresh milk in compliance with Indonesian National Standards (SNI) and converting waste into biogas, organic fertilizer, animal feed, and other cultivated commodities. The model serves multiple customer segments, including local consumers, tourists visiting the tourism café, and agribusiness actors in need of feed, fertilizer, or processed dairy products.

Distribution channels include direct sales at the tourism café and local outlets, partnerships with agricultural shops, supermarkets, and cooperatives, as well as digital marketing through social media, marketplaces, and the official website.

Revenue streams are derived from the sale of fresh milk, value-added dairy products (such as cheese, yogurt, and milk candy), by-products from waste (including organic fertilizer, animal feed, and cultivated commodities), and activities at the tourism café.

Key resources supporting KSL’s operations include dairy cattle, biogas installations, waste processing units, labor, tourism café facilities, and distribution networks. Key activities include milk production and distribution, waste processing, product development, marketing, and training cooperative members.

Key partnerships include dairy processing industries, research institutions, universities, local government, financial institutions, cooperatives, suppliers, and community organizations. The cost structure encompasses expenses for feed, livestock maintenance, waste processing, café operations, marketing, research, development, and production facility maintenance.

The additional take-back system component is implemented through the repurchase of biogas residues or fertilizers from farmers for reprocessing. Adaptation factors include regulatory compliance, land limitations, environmental commitment, and cost efficiency. The relationship between KSL’s activities and the SDGs is summarized in Table 3.

Table 3. Relevance of CE and SDGs

SDG	Information	Relevant activities
6	Clean water and sanitation	Sarangan is a highland area prone to water scarcity during the dry season. KSL provides clean water for farmers’ daily activities, while dairy cattle require clean water to maintain their health.
7	Affordable and clean energy	KSL has adopted livestock waste processing to produce biogas and fertilizer, with biogas serving as a substitute for LPG in cooking, electricity generation, and heating.
8	Decent work and economic growth	Through its organized system, KSL employs approximately 200 people, providing employment opportunities for the local community. KSL also supports surrounding SMEs by offering training and mentoring.
12	Responsible consumption and production	KSL produces its own cattle feed, packaged in bags. Farmers who buy the feed can return the packaging, effectively reducing product-related waste.
15	Life on land	Halting and reversing land degradation is one way to protect, restore, and promote the sustainable use of ecosystems. To reduce land degradation and improve soil fertility, KSL applies bio-slurry fertilizer—derived from biogas residues—to forage crops.

To complement the descriptive summary in Table 3, Figure 4 provides a visual representation of KSL’s contribution to the five SDGs, facilitating a clearer comparison of their relative significance.

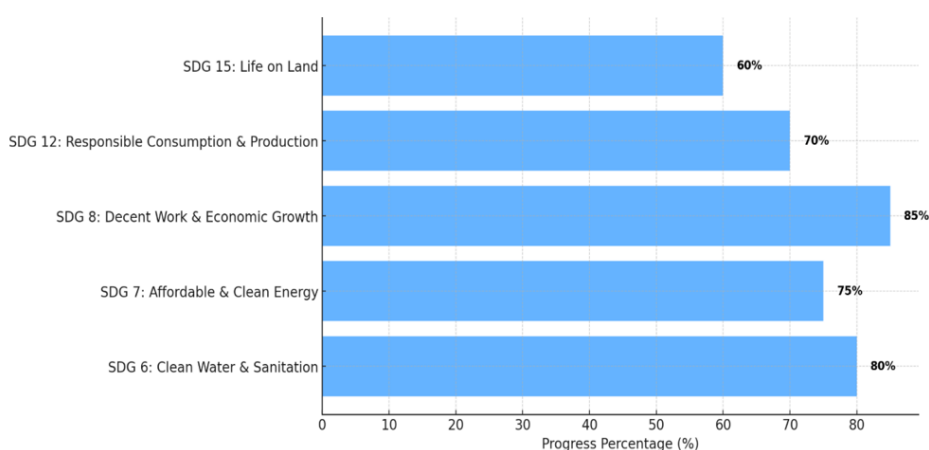


Figure 4. Contribution levels of KSL activities to the SDGs

The assessment shows the highest contribution to SDG 8 (85%), followed by SDG 6 (80%), SDG 7 (75%), SDG 12 (70%), and the lowest contribution to SDG 15 (60%).

For comparison, Table 5 presents the main differences between conventional farming practices, other circular economy models, and the redesigned CBMC at KSL.

Table 5. Comparison of the redesigned CBMC with conventional farming practices and other circular economy models

Aspect	Conventional farming	Other circular economy models	Redesigned CBMC for KSL
Waste Management	Manure and crop residues are often discarded, causing pollution.	Focuses on biogas and compost production, but has limited scalability.	Converts livestock waste into various value-added products, including biogas, organic fertilizer, and soil conditioners, thereby comprehensively reducing waste.
Revenue Sources	Limited to raw milk sales.	Introduces product diversification in niche markets.	Diversifies income sources through cheese production, biogas sales, organic fertilizer sales, and tourism café activities.
Environmental Impact	High greenhouse gas (GHG) emissions and water pollution.	Reduces emissions, but scalability may be limited across regions.	Achieves significant GHG emission reduction (up to 25% within five years) and improves soil and water quality through scalable practices.
Market Reach	Limited to local buyers.	Expands markets through niche targeting.	Leverages digital marketing and tourism to reach consumers at regional, national, and international levels with comprehensive market strategies.
Economic Resilience	Vulnerable to fluctuations in raw milk prices.	Moderately resilient with product innovation.	Builds resilience through multiple income sources, reducing dependency on milk prices, while involving tourism and eco-friendly products.
Stakeholder Engagement	Minimal collaboration with external parties.	Involves industry stakeholders, but with less community integration.	Engages farmers, local governments, environmental organizations, and consumers through a participatory approach in implementation.
Scalability	Limited by traditional methods and dependence on monoculture.	Scalable but often reliant on external funding.	Designed with adaptable practices for diverse regional contexts, combining environmental and economic sustainability in a scalable framework.

Financial feasibility analysis

A financial feasibility analysis was conducted to assess the prospects of the main business units developed within the redesigned CBMC, specifically the cheese processing unit, tourism café, and yogurt production facility. The evaluation used the Benefit–Cost (B/C) ratio under three demand scenarios: normal, peak, and low.

Table 2. B/C ratio calculation results

Revenue stream	Low	Normal	Peak
Cheese	0.02	2.47	6.00
Tourism café	0.01	2.42	6.75
Yogurt	0.03	2.50	7.55

The results show that under normal conditions, all three business units are financially feasible. The cheese processing unit recorded a B/C ratio of 2.47, the tourism café a ratio of 2.42, and the yogurt plant a ratio of 2.50.

Business performance improves significantly during peak conditions, typically occurring during holiday seasons or periods of high tourist inflows. In this scenario, the B/C ratios for cheese, the tourism café, and yogurt are 6.00, 6.75, and 7.55, respectively.

Conversely, under low-demand conditions, all units show B/C ratios below 1, indicating that they are financially unfeasible. This suggests that the revenues generated are insufficient to cover operating costs.

Environmental impact analysis

The environmental impact analysis of CBMC implementation at KSL focused on three main aspects: waste management, energy use, and natural resource conservation. In terms of waste management, the CBMC enables the conversion of livestock waste into value-added products, including biogas, organic fertilizer, and animal feed. Through the application of the take-back system, organic waste that would otherwise pollute the environment can be reprocessed, thereby reducing greenhouse gas emissions and minimizing water and soil pollution. With respect to energy use, the utilization of biogas as an alternative energy source for households and café operations helps reduce dependence on fossil-based energy. Finally, the application of organic fertilizer derived from waste processing contributes to natural resource conservation by maintaining soil fertility and reducing reliance on synthetic chemical fertilizers, while also promoting the development of a closed nutrient cycle that supports more sustainable local agriculture. Overall, the implementation of CBMC at KSL demonstrates significant potential to reduce the ecological footprint of dairy farming by integrating waste management, energy efficiency, and natural resource conservation.

Social impact analysis

The implementation of the redesigned CBMC at KSL generated identifiable social impacts across three main aspects: community empowerment, improved quality of life, and strengthened social cohesion. In terms of community empowerment, the model encourages active involvement of local farmers in the value chain, from milk production and waste processing to product marketing. Technical training programs, business mentoring, and facilitated access to financing enable farmers to enhance their capacity and skills. At the same time, the take-back system creates additional income opportunities from the sale of reprocessed waste residues. With respect to quality of life, the economic gains derived from product diversification and expanded marketing channels contribute to increased household income among farmers. Part of the profits is allocated to cooperative social programs, including scholarships for members' children, provision of insurance, clean water facilities, and healthcare support.

Additionally, the CBMC promotes social cohesion by fostering collaboration among farmers, local businesses, government agencies, educational institutions, and NGOs. Regular activities such as focus group discussions, annual evaluation meetings, and milk product festivals reinforce the collective identity of the farming community.

Overall, these social impacts reflect the integration of economic, environmental, and social dimensions within a single framework of community empowerment.

Discussion

The findings of this study highlight four major dimensions: the challenges of implementing the redesigned CBMC at KSL, the managerial implications of the redesigned model, the financial, environmental, and social impacts of CBMC implementation, and the alignment of these impacts with the SDGs. This section discusses these dimensions in light of relevant theoretical frameworks and empirical evidence, with a particular focus on how the redesigned CBMC addresses systemic barriers, enhances resilience, and contributes to sustainability. The discussion also contextualizes the results within broader debates on circular economy practices in smallholder dairy farming, offering insights for both local application and wider replication in similar settings.

Addressing the challenges of implementing CBMC at KSL

The findings of this study indicate that farmer resistance is the primary barrier to implementing the CBMC in KSL. This phenomenon aligns with the literature on innovation adoption in the agribusiness sector, which emphasizes that conservative behavior and attachment to traditional practices are often the primary obstacles to transformation (Chindasombatcharoen et al., 2024; Rizzo et al., 2024). To reduce resistance, participatory engagement strategies and education programs based on local experience can help build trust and demonstrate the tangible benefits of the circular economy.

Limited capital is the second major challenge. This aligns with studies in various developing countries, which indicate that access to financing is a crucial factor in promoting environmentally friendly practices (Turner, 2007). In KSL, the absence of inclusive financing schemes makes it difficult to invest in product diversification or waste treatment. Therefore, collaboration between local governments, microfinance institutions, and non-profit organizations is essential to provide financing instruments appropriate for community-scale enterprises.

A lack of knowledge among farmers regarding waste management is another significant obstacle. The practice of directly disposing of waste into the environment not only reduces the economic potential of biogas or organic fertilizer but also poses pollution risks. Previous studies have emphasized that the success of implementing a circular economy depends on enhancing technical capacity through training, mentoring, and hands-on demonstrations (Kirchherr et al., 2018). Thus, continuous technical training programs designed to meet local needs are highly necessary to ensure that the principles of reduce, reuse, and recycle (3R) are integrated into daily activities.

Seasonal demand fluctuations experienced by KSL highlight the importance of product diversification and market development strategies. The heavy reliance on fresh milk production makes the business vulnerable to seasonal fluctuations. The agrifood literature emphasizes the importance of diversifying value-added products, such as yogurt, cheese, or processed beverages, to stabilize income (Dahal et al., 2024; Grilli et al., 2024; Pokharel, 2019; Wang et al., 2024). In addition, leveraging digital platforms for marketing can help expand the consumer base and reduce dependence on the seasonality of local markets.

Limited policy support (10%) reflects institutional gaps in promoting circular economy practices at the local level. Without regulations, fiscal incentives, or a clear roadmap, community-based initiatives like KSL may struggle to survive and thrive. Case

studies in Europe show that proactive policies, such as incentives for renewable energy and waste management, play a vital role in accelerating the transition toward circular business models (Briguglio et al., 2021; Milios, 2021; Schmiedeknecht, 2024; Yen & Ha, 2025). Therefore, policy advocacy involving academics, civil society, and local business actors needs to be strengthened to create a more supportive institutional environment.

Overall, the results of this study emphasize that the success of CBMC implementation depends not only on the quality of business model design but also on the ability to overcome social, economic, technical, and institutional barriers. This supports the view that transitioning to a circular economy requires a systemic approach that combines economic incentives, capacity building, market diversification, and sustainable policy support.

Managerial implications of the redesigned CBMC at KSL

The redesign of the CBMC at KSL demonstrates that transitioning to a circular business model not only results in income diversification but also strengthens social and environmental sustainability. To ensure effective implementation, several managerial adjustments are necessary.

The value proposition emphasizes the importance of maintaining milk quality in compliance with Indonesian National Standards (SNI) while simultaneously introducing innovations through waste processing into value-added products. This aligns with the literature stressing value creation based on core quality and sustainable differentiation (Bocken et al., 2021). The customer segments, which are still concentrated in the local market, need to be expanded to regional and national levels, as Boldrini & Antheaume (2021) highlight that customer base expansion is a key success factor in circular businesses. Similarly, distribution channels—currently relying on the tourism café and local outlets—should be complemented with digital marketing strategies. Integrating online platforms has been shown to strengthen the market penetration of circular agrifood products and enhance consumer interaction (Scandurra et al., 2023).

Customer relationships can be reinforced through product bundling, community-based interactions, and direct farmer engagement. Cooperative-based approaches have proven effective in increasing consumer loyalty in agribusiness contexts (Turner, 2007). From the perspective of revenue streams, diversification into derivative products such as cheese, yogurt, organic fertilizer, biogas, and the tourism café is an important strategy to reduce dependence on fresh milk sales. This diversification is consistent with Ammari et al. (2025) and Damiano & Valenza (2025), who found that small enterprises can enhance resilience by exploring new revenue flows.

Key resources supporting this business model include quality dairy cattle, biogas installations, skilled labor, and tourism facilities. However, human resource capacity must continue to be improved through technical and entrepreneurial training. Key activities include milk production, waste processing, development of derivative products, digital marketing, and educational tourism activities. This concept reflects multifunctional agriculture, which integrates production, environmental considerations, and tourism (OECD, 2019). Strategic partnerships with cooperatives, local governments, financial institutions, universities, and NGOs are crucial for expanding financial and technical support, as emphasized by von Wirth et al. (2019), who highlighted the importance of multi-stakeholder collaboration in sustainable transitions.

Regarding the cost structure, the use of biogas for energy and bio-slurry for feed can reduce operational costs, in line with the literature, which highlights cost efficiency as one of the economic advantages of the circular economy (Kirchherr et al., 2018). The

take-back system, designed to repurchase biogas residues and fertilizers from farmers, provides a concrete example of a closed-loop system. Adaptation factors, such as regulatory compliance, land limitations, environmental commitment, and cost efficiency, reflect the relevance of the Triple Layered Business Model Canvas framework (Joyce & Paquin, 2016).

Furthermore, the redesigned CBMC illustrates several systemic improvements. The waste-to-resource approach and take-back system allow livestock waste to be processed into biogas, organic fertilizer, and animal feed, thereby reducing pollution while creating new income opportunities. The diversification of dairy products and the operation of a tourism café reduce reliance on fresh milk and expand market reach into tourism and urban consumer segments, enhancing resilience against seasonal fluctuations. The integration of digital marketing channels, including social media and marketplaces, expands the customer base, enhances brand visibility, and increases consumer engagement.

Compared to conventional practices in similar areas, which typically dispose of livestock waste without treatment, the CBMC model at KSL offers a comprehensive approach that integrates economic, environmental, and social dimensions. Unlike partial circular models focusing on a single aspect, such as biogas or compost production, the CBMC at KSL demonstrates advantages in scalability, market reach, and multi-stakeholder engagement. By combining a quality-oriented value proposition (SNI), technological innovation, and environmental awareness, the model has the potential to serve as a prototype that can be replicated in other smallholder dairy farming regions with similar economic and ecological characteristics.

The summary of managerial implications from the redesigned CBMC is presented in Table 4.

Table 4. Managerial implications

CBMC elements	Findings	Managerial implications
Value propositions	KSL’s primary objective is to maintain the quality of its milk products consistently. High-quality dairy cattle are also essential.	KSL must sustain innovative efforts to expand its product range, improve waste management, and increase cooperative surplus (SHU) for distribution to its members.
Customer segments	Currently concentrated in the Sarangan area.	KSL should expand its market share to regional and national levels.
Channels	Distribution relies mainly on the tourism café and local outlets.	KSL should maintain an updated website, actively use social media (Facebook, Instagram), and sell products on online marketplaces (Lazada, Agromaret, Tanihub). Dedicated marketing staff should be employed.
Customer relationships	Relationships are mostly informal and centered on farmers.	KSL can strengthen ties with farmers and general customers through product bundling and cooperative-based interactions.

CBMC elements	Findings	Managerial implications
Revenue streams	Heavy dependence on fresh milk sales.	KSL should diversify revenue by developing cheese, yogurt, organic fertilizer, biogas, and tourism café activities.
Key resources	Quality dairy cattle, biogas units, skilled labor, and tourism facilities.	Human resources need continuous improvement through technical and entrepreneurial training.
Key activities	Milk production and tourism are the main activities.	KSL should expand its services to include waste processing, product development, digital marketing, and educational tourism, while regularly updating its website.
Key partnerships	Limited collaboration with external stakeholders.	Partnerships with cooperatives, local government, universities, NGOs, and financial institutions are needed to expand financial and technical support.
Cost structure	Feed, maintenance, and energy costs remain high.	Biogas can substitute for electricity, and bio-slurry can fertilize grassland, reducing operational costs.
Take-back system	Waste handling is still suboptimal.	KSL should implement a closed-loop system by repurchasing biogas residues and fertilizers, and assisting farmers in managing manure.
Adaptation factors	Farmers' awareness of waste processing is still low.	KSL must raise awareness of sustainable practices, regulatory compliance, land efficiency, and environmental commitment.
Due diligence – Cheese & Yogurt	Milk is mostly sold raw.	KSL should process it into final products (cheese, yogurt) to increase added value.
Due diligence – Coffee tourism	Tourism potential remains untapped.	KSL should establish a tourism café to increase revenue and strengthen branding as a milk producer.
Potential diversification products	Potential applications include milk crackers, biogas fertilizer, worm feed, oyster mushroom substrate, strawberries, cattle/fish/poultry feed, and black soldier fly farming.	Farmers should be trained in product diversification to create additional income sources.

Financial, environmental, and social implications of CBMC implementation at KSL

The financial feasibility analysis indicates that the cheese processing unit, tourism café, and yogurt production are viable under both normal and peak conditions; however, they become unsustainable under low-demand conditions, as their break-even (B/C) ratios fall below 1. This finding is consistent with the literature, which emphasizes that agro-food businesses based on tourism are highly vulnerable to seasonal fluctuations (Turner, 2007).. Such conditions necessitate mitigation strategies, including diversifying value-added products, enhancing digital promotion to reach consumers beyond tourist areas, and developing educational tourism packages to sustain demand during off-peak periods. These strategies have been proven to stabilize cash flows and enhance the resilience of small and medium-sized enterprises in the agro-food sector (Garcia-Garcia et al., 2017).

From an environmental perspective, the implementation of CBMC at KSL demonstrates significant potential in reducing ecological footprints through improved waste management, enhanced energy efficiency, and effective conservation of natural resources. The conversion of livestock waste into biogas, organic fertilizer, and animal feed supports the principle of zero-waste production while reducing greenhouse gas emissions. This practice aligns with Kirchherr et al. (2018), who argue that the success of the circular economy hinges on integrating waste management into the business model. Furthermore, the use of biogas as a renewable energy source has the potential to reduce energy costs by 15–25% within five years, thereby not only lowering dependence on fossil fuels but also strengthening KSL's image as an environmentally friendly enterprise committed to reducing carbon emissions. This efficiency aligns with SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action).

From a social perspective, the implementation of CBMC generates tangible impacts on community empowerment, quality of life improvement, and social cohesion strengthening. Farmer involvement in the value chain, provision of technical training, and cooperative social programs (such as scholarships, insurance, clean water facilities, and healthcare support) demonstrate that the circular business model can function as a community empowerment instrument. This resonates with von Wirth et al. (2019), who emphasize the importance of multi-stakeholder collaboration in sustainable transitions. These positive social impacts strengthen community adaptive capacity, consistent with SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), and SDG 11 (Sustainable Cities and Communities).

The analysis of SDG linkages shows varying levels of contribution. The highest was to SDG 8 (Decent Work and Economic Growth) at 85%, reflecting increased employment and empowerment of local SMEs. SDG 6 (Clean Water and Sanitation) achieved 80% through effective clean water management systems and liquid waste control, followed by SDG 7 (Affordable and Clean Energy) at 75% through biogas utilization. SDG 12 (Responsible Consumption and Production) has achieved 70%, indicating the successful application of the reduce, reuse, recycle principles. Meanwhile, SDG 15 (Life on Land) recorded the lowest contribution at 60%, indicating the need for stronger efforts in soil conservation and protection of terrestrial ecosystems.

Overall, the integration of financial, environmental, and social dimensions within the CBMC at KSL underscores the relevance of the triple bottom line approach (economic–environmental–social) in developing community business models. The results also suggest that sustainability is determined not only by financial feasibility but also by tangible contributions to environmental conservation and social empowerment. Thus, the redesigned CBMC at KSL can be regarded as an applicable prototype for other

smallholder dairy farming areas in Indonesia with similar characteristics, while also providing empirical evidence of the role of circular business models in supporting the multidimensional achievement of the SDGs.

CONCLUSION AND RECOMMENDATIONS

Conclusion

By applying circular economy principles, the dairy farming business model in Sarangan has the potential to reduce waste and optimize resource use. Recycling cattle manure into biogas and organic fertilizer represents a core component of this process, supporting environmental sustainability. The B/C ratio analysis of Kampung Susu Lawu (KSL) confirms the financial feasibility of cheese processing, yogurt production, and the tourism café under normal and peak demand scenarios. However, all units become unviable under low-demand conditions, which may significantly affect long-term sustainability and profitability. This highlights the need for strategies to manage demand fluctuations and market uncertainties.

The redesigned CBMC demonstrates that product diversification—particularly into value-added dairy and waste-based products—can enhance income resilience while reducing greenhouse gas emissions and solid waste. These outcomes are directly linked to the multidimensional achievement of the SDGs, particularly SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land). Overall, the CBMC at KSL can be regarded as a prototype for other smallholder dairy–ecotourism communities in Indonesia with similar ecological and socio-economic characteristics.

Recommendations

In the short term, KSL should prioritize strengthening staff capacity through training on sustainable farming practices and waste management. At the same time, investing in digital branding and marketing is essential to enhance visibility, reinforce its reputation as the largest dairy cooperative in Magetan, and expand its consumer base beyond the tourism market.

For the long term, KSL needs to build stronger partnerships with local businesses, universities, NGOs, and government agencies to secure both financial and institutional support for sustainability. Product development should remain focused on dairy-based and waste-derived innovations (such as milk-based snacks, organic fertilizers, and biogas) rather than unrelated ventures, thereby reinforcing the core dairy–ecotourism ecosystem. In addition, active policy advocacy is crucial to promote supportive local regulations and incentives, enabling circular economy initiatives to grow and scale effectively. Beyond KSL, these recommendations also offer practical insights for other smallholder dairy–ecotourism communities in developing regions that seek to integrate circular economy practices while advancing the SDGs.

Future studies could expand the scope beyond a single community to test the applicability of CBMC across different dairy–ecotourism regions and consumer markets. Incorporating life cycle assessment (LCA), carbon accounting, and policy analysis would also provide a more comprehensive understanding of the environmental and institutional dimensions of circular business models in the agrifood sector.

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