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ERP AND BIG DATA-ENABLED BUSINESS MODEL CANVAS FOR SUSTAINABLE DAIRY COOPERATIVES IN WEST JAVA, INDONESIA

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ABSTRACT

Background: The Indonesian dairy industry requires a paradigm shift from traditional practices to digitally enhanced systems that prioritize sustainability and animal health. Smallholder farmers dominate the sector, yet milk quality remains a persistent challenge, with somatic cell counts exceeding national standards and mastitis costing farms approximately €175.20 annually.
Purpose: This study analyzes and characterizes innovative business models that integrate digital transformation technologies, particularly Enterprise Resource Planning (ERP) systems and Big Data analytics, as foundational capabilities for cooperative modernization.
Design/methodology/approach: Drawing upon empirical research conducted in April 2022 at KPS Cianjur Utara cooperative in West Java, Indonesia, complemented by recent developments in digital agriculture, this study presents an enhanced Business Model Canvas (BMC) framework that integrates ERP and Big Data dimensions alongside traditional sustainability and health system components.
Findings/results: The framework synthesizes nine foundational BMC elements with two critical sustainability dimensions and five digital transformation pillars: ERP infrastructure and integration, data governance and architecture, Big Data analytics capabilities, digital platforms and interfaces, and technological partnerships. ERP-enabled cooperatives can achieve superior outcomes in milk quality, production efficiency, and farmer livelihoods.
Conclusion: The proposed framework provides a pragmatic structure for formulating holistic business models that leverage integrated information systems and data-driven decision-making, laying the foundation for transformative change within the Indonesian dairy sector.
Originality/value (state of the art): This study advances the BMC framework by integrating ERP and Big Data dimensions explicitly, drawing upon resource-based view and dynamic capabilities theory, providing a novel tool for dairy cooperative transformation in developing country contexts.

Keywords: sustainable business models, digital transformation, ERP systems, dairy cooperatives, Indonesia

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INTRODUCTION

The trajectory of milk and dairy product consumption within Indonesia has marked a significant and consistent ascent over the past decade, driven by a confluence of demographic shifts, evolving health consciousness, and sustained economic growth. Per capita income in Indonesia reached USD 4,175 in 2019, while milk consumption demonstrated a steady annual growth rate averaging approximately 4% between 2017 and 2020 (BPS, 2020; MoA, 2016). This remarkable expansion underscores the evolving preferences of Indonesian consumers and the critical importance of a robust, sustainable dairy sector capable of meeting escalating domestic demand. However, the persistent gap between milk production and consumption reveals systemic challenges that threaten the long-term viability of Indonesia's dairy industry, attributable to intricate supply chain mechanisms, suboptimal dairy farming practices, and the complexities associated with scaling production to meet mounting consumer preferences (Moran and Morey, 2016).

Indonesia's dairy landscape is distinctly shaped by the prevalence of smallholder farmers who form the bedrock of the sector, characterized by farms with modest dimensions where the average ownership of milking cows per farm remains strikingly low (Guntoro, et al.2016). Java Island emerges as the pivotal epicenter of milk production, with an astonishing 98.6% of Indonesia's overall dairy cattle population concentrated within its confines (BPS, 2022). West Java demonstrates the highest productivity levels among provinces, reaching 2,175 kg of milk per cow annually, while contributing substantially to rural livelihoods and smallholder household economies (Jahroh, et al.2020).

Despite the sector's economic importance, milk quality remains a persistent challenge that threatens both consumer confidence and farm profitability. Research conducted at KPS Cianjur Utara cooperative revealed that the mean geometric somatic cell count (SCC) across 119 member farms reached 529,665 cells/mL (Figure 1), substantially exceeding the Indonesian National Standard maximum of 400,000 cells/mL for fresh milk (Fadillah, et al.2023). Similarly, total plate count (TPC) measurements indicated bacterial contamination levels averaging 474,492 cfu/mL, approaching the maximum permissible limit of 1,000,000 cfu/mL (Fadillah, et al.2023; BSN, 2011). These quality deficiencies stem from multiple interconnected factors: high mastitis prevalence resulting from suboptimal udder health management, inadequate milk harvesting hygiene practices, limited availability of cooling infrastructure on-farm and during transit, and insufficient farmer knowledge regarding quality parameters and their economic implications (Fadillah, et al.2023; Hetherington, et al.2023).

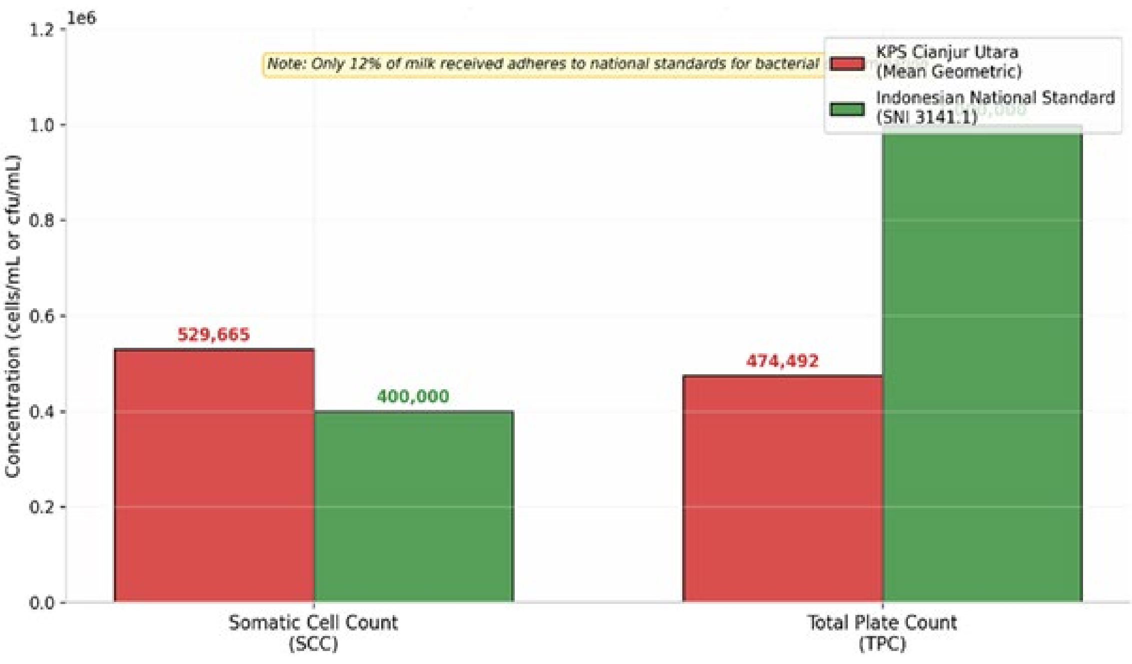

Figure 1. Milk quality parameters at KPS Cianjur Utara coperative and Indonesian National Standard (Fadillah et al. 2023)

The economic consequences of poor udder health are substantial. Mastitis alone costs smallholder farms approximately €175.20 annually per farm of four cows representing 14% of annual gross margin, rising to 36% at the 95th percentile of cost distribution (Fadillah, et al.2025) (Figure 2). Clinical mastitis costs were primarily driven by culling (45%) and discarded milk (27%), whereas subclinical mastitis costs were shared between production loss (52%) and blanket dry cow therapy (48%). These findings reveal that the economic burden of mastitis on Indonesian smallholder farms is higher than in Ethiopia (€31.26) but lower than in the Netherlands (€78) and Sweden (€97), with differences largely attributable to variations in labor costs (Fadillah, et al.2025; Huijps, et al.2008; Getaneh, et al.2017).

The transformation of the dairy industry from conventional to modern, improved systems necessitates the incubation of novel business models that integrate circular economies, sustainable business practices, innovative value chain organization, and increasingly digital technologies such as Enterprise Resource Planning (ERP) systems and Big Data analytics (Osterwalder and Pigneur, 2010; Joyce and Paquin, 2016). The recent digital transformation of Indonesia's dairy sector, exemplified by the ERP system implementation at the South Bandung Livestock Cooperative (KPBS) in Pangalengan and its subsequent expansion to three additional cooperatives in East Java, demonstrates the transformative potential of integrated information systems (ILO, 2025). These developments have streamlined logistics, membership management, and animal health monitoring while reinforcing the entire dairy value chain, with mobile loan approval facilities processing 429 farmer loans totaling IDR 11.6 billion in just one day.

This study addresses the critical need for comprehensive frameworks that guide dairy cooperatives in navigating this complex transformation through the strategic deployment of ERP systems and Big Data analytics. By integrating sustainable practices, health systems, and digital innovation into a unified business model architecture grounded in ERP and Big Data theory, this research provides actionable insights for cooperative managers, policymakers, and development practitioners seeking to modernize dairy operations in Western Java and similar contexts throughout the developing world.

METHODS

This study draws upon empirical research conducted in April 2022 at KPS Cianjur Utara cooperative in West Java, Indonesia, complemented by recent developments in digital agriculture and ERP implementations across Southeast Asia. Primary data included milk quality measurements (SCC and total plate count) from 119 member farms, farmer management practice surveys, and economic assessments of mastitis control strategies..

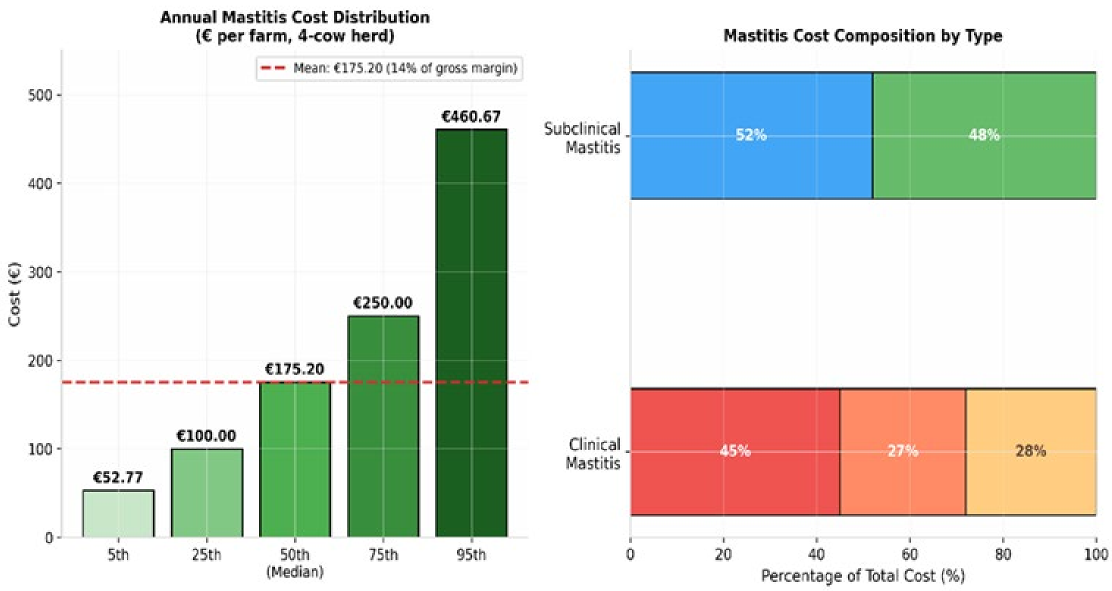

Figure 2. Economic burden of mastitis on Indonesian smallholder dairy farms (Fadillah et al. 2025)

Data collection employed structured farmer interviews, on-farm observations of milking hygiene and manure management practices, milk sampling for laboratory quality analysis, and documentation of cooperative operational and financial records. Secondary data included peer-reviewed literature on ERP implementation in agricultural cooperatives and Big Data applications in livestock management.

Quantitative analysis of milk quality data utilized multivariate regression to identify risk factors associated with SCC and TPC. Economic analysis employed stochastic bio-economic modeling to assess cost-efficiency of mastitis control strategies. Qualitative synthesis of ERP implementation case studies informed the development of the expanded Business Model Canvas framework, grounded in resource-based view and dynamic capabilities theory.

The research posits that integrated ERP-Big Data capabilities constitute strategic resources enabling dairy cooperatives to achieve sustainable competitive advantage. The framework synthesizes nine foundational BMC elements with sustainability dimensions and five digital transformation pillars, providing a pragmatic structure for cooperative business model innovation.

RESULTS

The Expanded Business Model Canvas Framework

Drawing upon the foundational BMC structure (Osterwalder and Pigneur, 2010) while incorporating ERP and Big Data theoretical perspectives, this study proposes an Expanded Business Model Canvas for Dairy Cooperatives comprising sixteen interconnected elements organized into four dimensions (Figure 3): Foundation Dimension (traditional BMC elements), Sustainability Dimension (mission statement and impact measurement), and ERP and Big Data Transformation Dimension (ERP infrastructure and integration, data governance and architecture, Big Data analytics capabilities, digital platforms and interfaces, and technological partnerships).

Foundation Dimension Elements

Customer Segments. The ERP-enabled dairy cooperative serves multiple customer segments with distinct needs and value expectations. Primary segments include: (1) smallholder dairy farmers who require health services, supplies, market access, and digital tools for farm management; (2) dairy processors seeking consistent, high-quality raw milk supplies with traceability documentation enabled by ERP-tracked quality data; (3) end consumers increasingly demanding transparency regarding production practices and product provenance, which blockchain-enabled ERP systems can provide; and (4) institutional customers such as government agencies and development organizations interested in sector development outcomes. Farmers' awareness of milk quality parameters significantly influences their management practices, suggesting that cooperatives must treat farmers not merely as suppliers but as customers requiring education and support delivered through digital platforms (Fadillah, et al.2023).

Value Propositions. The core value proposition centers on creating a sustainable dairy business model that delivers superior milk product quality, increased production quantity, plentiful acceptable fresh milk supply, enhanced milk accessibility, and an efficient cow health care system all achieved at reasonable cost while maintaining digital connectivity through ERP systems. Post milking teat disinfection provided positive net economic benefit of €26.05 per farm annually, suggesting that cooperative-led interventions can deliver measurable financial value to members (Fadillah, et al.2025). ERP systems enable cooperatives to extend this value proposition through data-driven advisory services: predictive analytics can identify farms at risk of mastitis outbreaks, benchmarking can highlight improvement opportunities, and automated alerts can prompt timely interventions.

Channels. Distribution channels operate through multiple pathways optimized for reach and accessibility: direct selling arrangements, local store partnerships, farmers' group aggregation channels, strategically positioned milk collection points equipped with digital quality testing equipment integrated into ERP systems, and emerging e-commerce platforms that connect producers directly with quality-conscious consumers. Digital channels including mobile applications and web-based interfaces connected to ERP systems increasingly complement physical infrastructure, enabling remote monitoring, virtual extension services, and digital payment systems that automatically update member accounts.

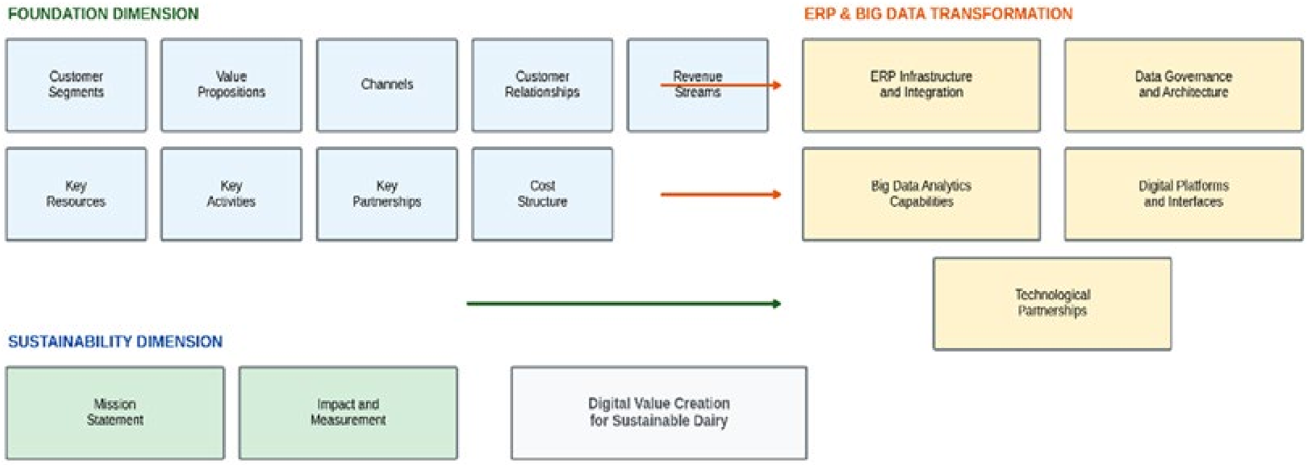

Figure 3. Expanded business model canvas for ERP and big data enabled sustainability dairy cooperatives

Customer Relationships. Relationship management emphasizes partnership contracts that formalize mutual commitments between cooperatives and members, supplemented by dedicated personal assistance programs delivered through both face-to-face extension and digital advisory services informed by Big Data analytics. Loyalty-building mechanisms include performance-based incentive programs where ERP-tracked quality data determines premium payments, digital literacy training, and participatory governance structures supported by transparent data sharing that ensures farmer voices shape cooperative priorities. The finding that farmers who received mastitis treatment training achieved SCC reductions of 0.71 to 0.77 units (Fadillah, et al.2023). underscores the importance of cooperative-farmer relationships in driving quality improvement relationships that can be strengthened through data-driven identification of farmers most in need of targeted support.

Revenue Streams. Diversified revenue sources include raw milk sales (with quality-based premium pricing enabled by ERP-tracked quality metrics), processed milk products, health services and veterinary supplies, digital service subscriptions providing farmers access to advanced analytics and advisory tools, data monetization through anonymized benchmarking services (subject to appropriate data governance frameworks), and financial services including mobile loan facilitation powered by digital credit scoring. The ERP-enabled mobile loan system implemented at KPBS Pangalengan, which processed IDR 11.6 billion in loans with same-day approval, exemplifies the revenue potential of integrated digital financial services (ILO, 2024)

Key Resources. Critical resources encompass physical capital (milk collection point facilities, milk tank vehicles, production plants, digital sensors and IoT devices), production equipment and materials, human resources (including ERP system administrators, data analysts, and digitally skilled extension personnel), financial resources, and increasingly, data resources aggregated from member farm operations through ERP systems. The cooperative's digital infrastructure including cloud computing capabilities, cybersecurity systems, and mobile application platforms constitutes an emerging resource category essential for competitive operations. From a resource-based view perspective, the integrated ERP-Big Data capability constitutes a particularly valuable strategic resource due to its complexity and path dependency (Wade and Hulland, 2024; Teece, 2007).

Key Activities. Core activities span milk collection and quality assessment (with results entered into ERP systems), processing and value addition, marketing and market development, partnership establishment and management, quality assurance systems operation, animal health monitoring and veterinary services, and critically ERP system management, data analytics, and continuous system improvement. The integration of these activities through ERP systems enables workflow optimization and real-time decision support, addressing the quality challenges identified by Fadillah et al. (2023) where SCC and TPC levels exceeded national standards.

Key Partnerships. Strategic partnerships extend across government bodies (for policy support, regulatory compliance, and potentially co-investment in ERP infrastructure), input suppliers (for quality-assured feed and veterinary products), dairy farmers (as members and co-producers whose data enriches cooperative analytics), the National Dairy Cooperative Union (GKSI) for sector-wide coordination and potential ERP standardization, technology providers (for ERP software, cloud infrastructure, and technical support), research institutions (for analytics algorithm development and validation), and financial service providers (for integrated credit and insurance products that leverage ERP data for risk assessment). These partnerships are essential for implementing the cost-efficient control strategies identified by Fadillah et al. (2025) such as post milking teat disinfection, which required iodine, dippers, and training that individual farmers might not access independently.

Cost Structure. Operating costs include traditional categoriesoperating expenses, marketing costs, production costs, research and development investmentssupplemented by ERP and Big Data infrastructure costs (software licensing, cloud services, data storage, cybersecurity), data management expenses (data cleaning, integration, governance), analytics talent costs (data scientists, analysts), and technology partnership fees. The shift from capital-intensive physical infrastructure to operational expenditure-based digital services (Software-as-a-Service models) may alter cost structures favorably for resource-constrained cooperatives, enabling them to access enterprise-grade ERP capabilities without prohibitive upfront investments.

Sustainability Dimension Elements

Mission Statement. The cooperative business model's overarching mission centers on enhancing dairy business sustainability through multiple pathways: improving health systems within dairy farms, increasing milk production and quality, elevating cooperative income streams, and ultimately uplifting dairy farmers' livelihoods. This mission explicitly integrates environmental stewardship, animal welfare, economic viability, and social equity as interconnected objectives rather than competing priorities. The substantial economic burden of mastitis€175.20 per farm annually representing 14% of gross margin (Fadillah et al.2025) provides compelling justification for health system improvement as a central mission component, with ERP systems providing the measurement infrastructure to track progress.

Impact and Measurement. Success measurement encompasses quantifiable indicators across multiple domains: milk quality parameters (TPC, SCC, milk density, total solids, fat and protein content) captured through ERP-integrated quality testing; production volume metrics aggregated across member farms; sales and income levels tracked through financial modules; health system performance indicators (mastitis incidence rates, veterinary intervention frequency, animal welfare scores); and digital adoption metrics (ERP system utilization rates, farmer digital literacy scores, mobile transaction volumes). Clinical and subclinical mastitis costs reached €101.98 and €73.22 per farm annually, providing baseline measurements against which intervention impacts can be assessed (Fadillah et al.2025). ERP systems enable systematic, continuous measurement against these indicators, supporting evidence-based management and providing accountability to members and external stakeholders.

ERP and Big Data Transformation Dimension Elements

ERP Infrastructure and Integration. This element encompasses the hardware, software, and connectivity foundations enabling cooperative operations. Core components include: integrated ERP software modules covering financial management, supply chain operations, membership administration, and animal health tracking; cloud computing infrastructure for scalable data storage and processing; Internet of Things (IoT) sensors for environmental monitoring, animal health tracking, and milk quality assessment, with data streaming directly into ERP systems; mobile network connectivity ensuring field-level access for remote member farms; and cybersecurity systems protecting sensitive farm and financial data. The successful ERP implementation at KPBS Pangalengan, which expanded to three additional East Java cooperatives in 2024–2025, demonstrates the transformative potential of robust ERP infrastructure. Following the ERP lifecycle model (Markus and Tanis, 2000), cooperatives must navigate the project chartering, configuration and rollout, shakedown, and onward and upward phases sequentially to realize full value from their ERP investments.

Data Governance and Architecture. Effective Big Data analytics requires robust data governance frameworks that ensure data quality, security, privacy, and appropriate use. Key governance components include data ownership policies clarifying member rights to farm data and cooperative rights to aggregated data; data quality standards and validation procedures ensuring analytics are based on accurate inputs; security protocols protecting sensitive information; and ethical guidelines governing data use, particularly for analytics that influence member access to credit or premium pricing. Data architecture must accommodate diverse data types: structured transactional data from ERP systems, semi-structured data from IoT sensors, and unstructured data from veterinary notes and extension interactions. This architecture must enable the integration of internal cooperative data with external datasetsweather patterns, market prices, disease surveillanceto generate comprehensive insights (Wamba et al,. 2017).

Big Data Analytics Capabilities. Beyond data collection and governance, cooperatives must develop analytical capabilities for transforming data into actionable intelligence. Essential capabilities include: descriptive analytics providing real-time visibility into operationsmilk quality trends, member performance rankings, financial positions; diagnostic analytics identifying root causes of quality issueslinking specific management practices to SCC outcomes as demonstrated by Fadillah et al. (2023); predictive analytics for mastitis early warning, reproductive management, and production forecasting; prescriptive analytics generating actionable recommendationswhich farms require training interventions, which interventions will yield greatest impact; and benchmarking analytics comparing member farm performance against anonymized peer groups to motivate improvement. These capabilities require investment in analytical talent, algorithm development, and validation partnerships with research institutions (Elgendy and Elragal (2014).

Digital Platforms and Interfaces. User-facing digital systems make sophisticated ERP and Big Data capabilities accessible to farmers regardless of technical background. Essential platforms include: mobile applications for daily farm management, enabling farmers to record milk production, health events, and management practices with data flowing directly into cooperative ERP systems; farmer dashboards providing real-time visibility into milk quality results, production rankings, and financial positions; digital payment and financial management tools integrated with ERP financial modules; e-learning platforms delivering targeted training content based on analytics-identified needs; and traceability interfaces enabling consumers to verify product provenance, building trust and enabling premium pricing. Effective platforms must accommodate intermittent connectivity, support local languages, provide intuitive visual interfaces, and demonstrate immediate practical value to drive adoption among farmers with varying digital literacy levels.

Technological Partnerships. Given the specialized expertise required for ERP implementation and Big Data analytics development, cooperatives must cultivate strategic partnerships with: agricultural technology companies (agritech firms) offering tailored ERP solutions for cooperative contexts; ERP vendors with experience in agricultural deployments; telecommunications providers ensuring connectivity for remote member farms; cloud service vendors providing scalable infrastructure; research institutions validating analytical algorithms and approaches; and government agencies supporting digital literacy programs and infrastructure development. Following the dynamic capabilities framework (Teece, 2007), these partnerships enable cooperatives to sense digital opportunities, seize them through appropriate investments, and transform operations accordingly while maintaining cooperative autonomy and data sovereignty.

ERP Implementation for Cooperative Management

The KPBS Pangalengan case demonstrates comprehensive ERP functionality including milk production and reception data recording with real-time quality test integration, logistics optimization, membership database administration, financial accounting, and animal health monitoring. The system's mobile loan approval facility reduced loan processing from weeks to a single day, with 429 farmers securing IDR 11.6 billion in financing during the initial operational period (ILO, 2024). From a dynamic capabilities perspective, ERP implementation transforms cooperative sensing capabilities by providing real-time visibility into member performance and market conditions (Teece, 2007; Pavlou, and El Sawy, 2006).

Big Data Analytics for Health Monitoring

Big Data analytics enables precision approaches to livestock management previously inaccessible to smallholder-dominated cooperatives. Research has established that machine learning models analyzing behavioral data can detect mastitis and lameness earlier than visual observation. Given that post milking teat disinfection was identified as the only cost-efficient control strategy (Fadillah, et al,. 2025), predictive analytics could identify additional intervention opportunities. The identification of risk factors associated with SCC and TPCmanure removal frequency, training history, udder washing practices (Fadillah, et al,. 2023) enables development of predictive models that flag farms at risk of quality deterioration.

Data-Driven Decision Support and Digital Financial Services

Digital platforms deliver personalized recommendations to farmers based on performance data, peer benchmarks, and predictive models. The finding that farmers who received mastitis treatment training achieved SCC reductions of 0.71 to 0.77 units (Fadillah, et al,. 2023) demonstrates that training interventions are effective, and Big Data analytics can identify which farmers would benefit most. Integration of financial services into digital cooperative platforms addresses barriers to smallholder credit access. Digital credit scoring based on production data enables lending without traditional collateral, while mobile payment systems reduce transaction costs and accelerate payment cycles.

Digital Financial Services and Inclusion

Integration of financial services into digital cooperative platforms addresses longstanding barriers to smallholder credit access that constrain investment in quality improvement. Digital credit scoring based on production data and cooperative transaction histories, enabled by ERP systems, enables lending to farmers without traditional collateral that may be unavailable. Mobile payment systems integrated with ERP financial modules reduce transaction costs, improve financial transparency, and accelerate payment cycles. Index-based insurance products, triggered by verified production data rather than subjective assessments, can protect farmers against climate and disease risks.

Managerial Implications: Phased ERP Implementation Strategy

Successful implementation of the expanded BMC framework requires phased progression through the ERP lifecycle that builds capabilities progressively while demonstrating value at each stage (Markus and Tanis, 2000). The roadmap follows the ERP lifecycle model through four sequential phases, with critical success factors emphasizing governance, change management, and member engagement throughout the transformation journey (Figure 4).

Phase 1: Project Chartering (Months 1–6). Establish governance structures, define project scope, secure funding, select ERP platform and implementation partners, and develop change management strategy. Critical success factors include cooperative leadership commitment, member engagement in design decisions, and realistic expectations about implementation timeline and organizational change requirements. Early stakeholder alignment on data governance principlesparticularly regarding member data ownership and privacyis essential.

Phase 2: Configuration and Rollout (Months 6–18). Configure ERP modules for cooperative-specific processes: member management, milk collection and quality testing, financial accounting, and loan management. Develop interfaces for IoT sensors at collection points. Conduct training for cooperative staff and extension personnel. Pilot implementation with early-adopter farmer groups before full rollout. This phase requires significant change management as operational routines transform and staff develop new competencies.

Phase 3: Shakedown (Months 18–24). Stabilize system operations, address technical issues, refine business processes based on early experience, and achieve initial performance targets. The shakedown phase is particularly critical for cooperatives given the limited tolerance for operational disruption among smallholder members who depend on predictable milk collection and payment cycles. Success during this phase requires dedicated support resources and responsive vendor partnerships.

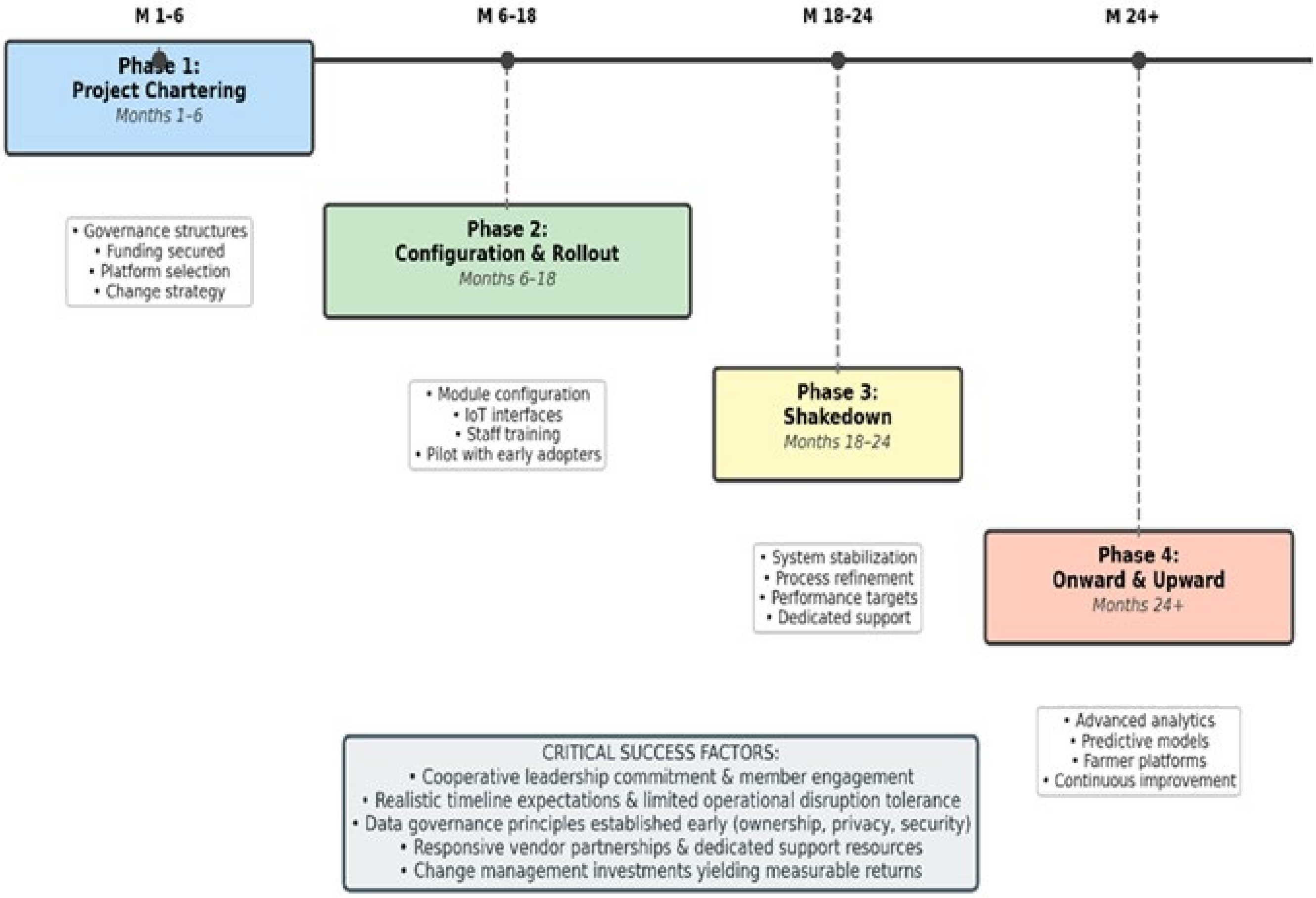

Figure 4. Phased ERP implementation strategy for dairy cooperative

Phase 4: Onward and Upward (Months 24+). Extend ERP capabilities to incorporate advanced analytics, implement predictive models for health monitoring, develop farmer-facing digital platforms, integrate additional data sources (weather, market prices), and establish continuous improvement processes. This phase focuses on leveraging the ERP foundation to create strategic value through Big Data analytics, moving beyond operational efficiency to business model innovation.

Sustainability Impacts and SDG Alignment

The ERP and Big Data-enabled business model framework generates multidimensional sustainability impacts aligned with SDG 2 (Zero Hunger) and SDG 13 (Climate Action) (Figure 5). ERP-optimized dairy production increases milk output and quality while reducing losses, directly contributing to food security. The total mastitis cost of €175.20 per farm annually (Fadillah, et al,. 2025) indicates substantial productivity losses that ERP-enabled interventions could recover. ERP systems enable environmental monitoring, reducing greenhouse gas emissions per unit of production through improved feed efficiency and manure management. The finding that manure removal frequency was significantly associated with both SCC and TPC (Fadillah, et al,. 2023) suggests optimized manure management simultaneously improves milk quality and reduces environmental impacts.

SDG 2: Zero Hunger. ERP-optimized dairy production increases milk output and quality while reducing losses, directly contributing to food security. The total mastitis cost of €175.20 per farm annuallyrepresenting 14% of gross margin (Fadillah, et al.2025) indicates substantial productivity losses that ERP-enabled interventions could recover. Improved animal health reduces mortality and maintains production capacity. Enhanced farmer incomes enable investment in household nutrition and education. The precision agriculture approaches enabled by Big Data analytics maximize productive output from limited resource bases while reducing waste.

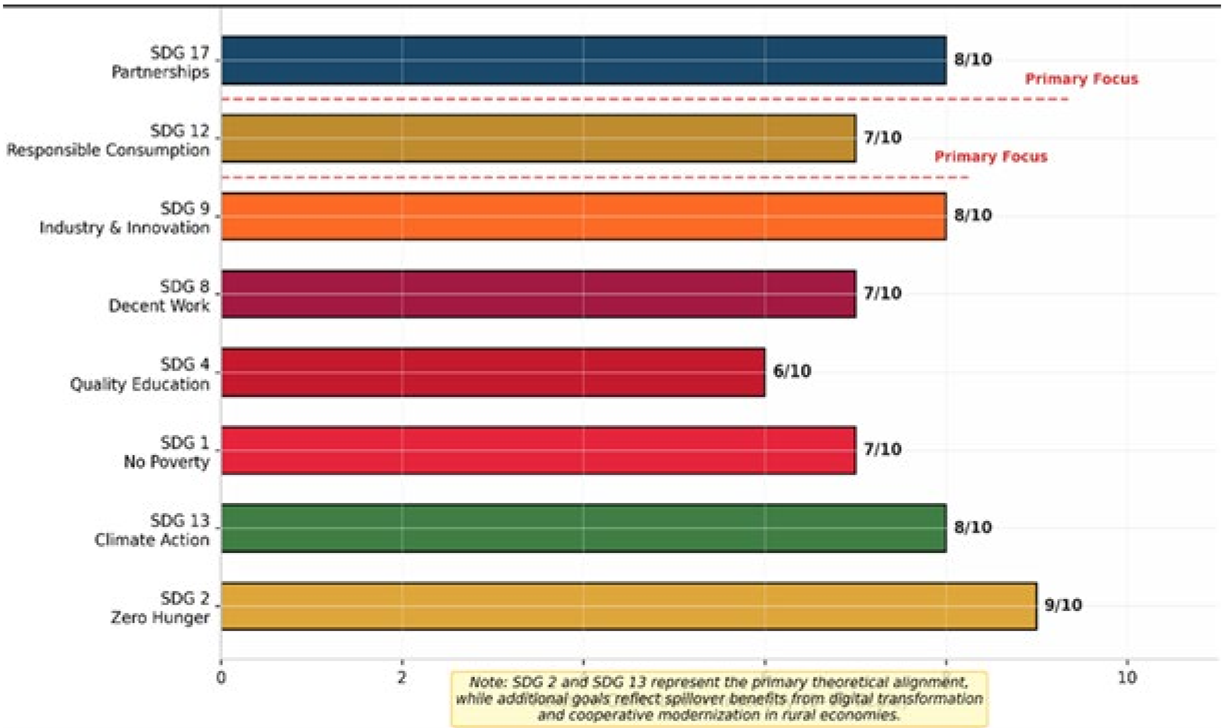

Figure 5. Sustainability impacts and SDG alignment of the ERP and big data-enabled dairy cooperative business model

SDG 13: Climate Action. ERP systems enable environmental monitoring and optimization that reduce greenhouse gas emissions per unit of production through improved feed efficiency and manure management. Big Data analytics supports climate adaptation capabilities, including heat stress prediction and early warning systemsthat build resilience to climate change impacts. Data-driven breeding decisions can select for climate resilience, contributing to long-term adaptation. The finding that manure removal frequency was significantly associated with both SCC and TPC (Fadillah, et al.2023) suggests that optimized manure management can simultaneously improve milk quality and reduce environmental impactsa co-benefit that ERP systems can help capture.

Additional SDG Contributions. The framework supports: SDG 1 (No Poverty) through enhanced farmer incomes and financial inclusion enabled by digital credit scoring; SDG 4 (Quality Education) through digital learning platforms and extension services that leverage analytics to target training; SDG 8 (Decent Work and Economic Growth) through improved cooperative viability and rural employment; SDG 9 (Industry, Innovation, and Infrastructure) through ERP infrastructure development; SDG 12 (Responsible Consumption and Production) through waste reduction and traceability systems; and SDG 17 (Partnerships for the Goals) through the multi-stakeholder collaboration essential for successful ERP implementation.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study has presented an expanded Business Model Canvas framework for dairy cooperatives integrating sustainability imperatives, health system enhancements, and ERP and Big Data transformation technologies. Drawing upon empirical research in West Java and emerging best practices from ERP implementations across Southeast Asia, the framework provides a comprehensive architecture for cooperative business model innovation grounded in resource-based view, dynamic capabilities theory, information processing theory, and the knowledge-based view.

The research demonstrates that ERP systems and Big Data analytics fundamentally reconfigure how cooperatives create, deliver, and capture value, enabling new forms of value proposition including data-driven advisory services, transparent quality assurance, and inclusive financial products. The successful ERP implementation at KPBS Pangalengan demonstrates the practical viability of digital integration in

Indonesian dairy cooperatives. Realizing these benefits requires addressing challenges including connectivity limitations, variable digital literacy, data governance concerns, and organizational change management.

Recommendations

Recommendations for cooperative managers include implementing a phased ERP strategy progressing from project chartering through configuration, shakedown, and continuous improvement. Policymakers should support ERP infrastructure investment and digital literacy programs. Development practitioners should facilitate multi-stakeholder partnerships essential for successful implementation. Future research should examine long-term impacts of ERP implementation on cooperative governance, member equity, and sector-wide competitiveness, as well as investigate emerging technologies including artificial intelligence for predictive health monitoring.

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