DESIGNING A SUSTAINABLE BUSINESS MODEL FOR CATTLE MANURE-BASED ORGANIC FERTILIZER

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Abstract

The cattle farming industry in Indonesia has experienced significant growth, with the population increasing from 14.8 million head (2014) to 18.8 million head (2023). This industry generates approximately 137.2 million tons of waste annually, yet only 30% is processed into value-added products. This research aims to design a sustainable business model for converting cattle farm waste into organic fertilizer. The study employs a qualitative approach with case studies across three scales of cattle farming operations in Bogor and Cianjur Regencies. Analysis was conducted using the Business Model Canvas (BMC), Value Chain Analysis, and PESTEL framework. Results identify four key driving factors in the cattle waste processing business: infrastructure and technology (GM=4.64-5.00), HR management (GM=4.00-5.00), procurement (GM=4.47-5.00), and inbound logistics (GM=4.47-5.00). A Central Processing Unit (CPU) model was designed with a capacity of 25 tons of cattle waste per day. Feasibility analysis indicates an investment requirement of IDR 11.5 billion, yielding a 12-month payback period, NPV of IDR 59.39 billion, and IRR of 100.3%. The model demonstrates economic sustainability through multiple revenue streams with projected annual revenue of IDR 21.24 billion, positive environmental impact through 60% emission reduction, and social contribution by creating 23-25 new jobs.

Keywords: Sustainable Business Model, Organic Fertilizer, Cattle Farm Waste, Business Model Canvas, Value Chain Analysis

INTRODUCTION

The cattle farming industry in Indonesia has experienced significant growth over the past decade. The Central Bureau of Statistics (2023) recorded an increase in cattle population from 14.8 million head in 2014 to 18.8 million head in 2023, with an average annual growth rate of 2.7%. This growth has been driven by increasing national animal protein consumption, which rose from 2.85 kg/capita/year to 3.42 kg/capita/year during the same period (Directorate General of Livestock and Animal Health 2023a).

The increasing livestock population directly impacts the volume of waste generated. The Directorate General of Agricultural Product Processing and Marketing (2015) reported that with a standard waste production of 25-30 kg/head/day, the total waste generated reaches 376,000 tons per day or 137.2 million tons annually. Suboptimal waste management creates a cascading effect in the sustainable food system. The Ministry of Environment and Forestry (2023) noted that the livestock sector contributes 14.3% of total national emissions. Gerber (2013) revealed that improper waste management significantly contributes to greenhouse gas emissions, while Jamaludin et al (2020) estimated the emission reduction potential of up to 60% through integrated waste processing.

Amrullah et al (2024) disclosed that smallholder cattle farming development faces challenges in waste management due to technological and capital limitations. This aligns with Latif's (2022) findings that only 30% of total waste is processed into value-added products, while the remaining 70% is disposed of without adequate treatment. The Directorate General of Livestock and Animal Health (2023b) revealed a lost potential added value of up to IDR 28.5 trillion annually due to suboptimal waste management.

In this context, the integration of Business Model Canvas (BMC), Value Chain Analysis, and PESTEL methodologies offers a comprehensive analytical framework. BMC (Osterwalder & Pigneur, 2010) enables visualization and integration of nine key business model elements. Value Chain Analysis (Porter 1985) facilitates value creation optimization from upstream to downstream, while PESTEL analysis ensures that the developed model is responsive to external dynamics.

The processing capacity gap between different business scales creates a paradox in the system: small farms cannot process their waste, while large processing units face suboptimal capacity utilization. Latif et al (2023a) revealed that small-scale farms lose the potential income of up to IDR 15 million per year, while large-scale processing units operate at only 70% of capacity on average.

Simultaneously, Indonesia's agricultural sector faces serious challenges related to land productivity and organic fertilizer requirements. APPI (2023) data shows an organic fertilizer deficit of 1.7 million tons, with national demand reaching 13.5 million tons while domestic production is only 11.8 million tons. The Indonesian Ministry of Agriculture (2021) projects a 25% annual increase in demand, in line with policies to reduce inorganic chemical fertilizer use. This research aims to design a sustainable business model suitable for developing an organic fertilizer industry based on cattle farm waste.

REVIEW OF LITERATURE

Sustainable business models integrate economic, environmental, and social dimensions to create long-term value (Schaltegger et al., 2016; Yudha & Basya, 2023; Mulya, 2024). Teece (2018) defines a business model as the rational framework for how organizations create, deliver, and capture value. The Business Model Canvas (BMC) by Osterwalder and Pigneur (2010) provides a structured approach to visualize business models through nine interconnected components, making it relevant for analyzing the complexity of sustainability challenges in agriculture (Barth et al., 2017).

Value Chain Analysis (Porter, 1985) complements BMC by identifying upstream and downstream value creation activities. Ustriyana (2014) explains that in livestock waste management, value chain effectiveness depends on optimizing each component, from collection to final processing. This analysis divides activities into two categories: primary activities (inbound logistics, operations, outbound logistics, marketing, and service) and support activities (infrastructure, human resource management, technology development, and procurement).

The cattle farming sector in Indonesia contributes significantly to national greenhouse gas emissions (Kementerian Lingkungan Hidup dan Kehutanan, 2023). Achinas et al. (2017) emphasize that proper waste processing can significantly reduce these emissions. Livestock waste contains valuable nutrients for sustainable agriculture, with main compositions of organic matter, nitrogen, phosphorus, and potassium (Ditjen Pengolahan dan Pemasaran Hasil Pertanian, 2015).

To analyze external factors influencing the organic fertilizer industry development, the PESTEL framework provides a comprehensive structure covering political, economic, social, technological, environmental, and legal aspects (Rothaermel, 2015). Yüksel (2012) emphasizes the importance of PESTEL in identifying macro factors that can affect the successful implementation of business models. The integration of these three analytical frameworks—BMC, Value Chain, and PESTEL—enables a comprehensive understanding of internal and external aspects influencing the development of a sustainable business model for the cattle farm waste-based organic fertilizer industry.

RESEARCH METHOD

Study Area and Duration

This study was conducted in Bogor and Cianjur Regencies, West Java Province, Indonesia. These locations were chosen due to their high cattle population density and diverse farm scales, ranging from small-scale farms (5–20 cattle) to medium-scale farms (21–100 cattle) and large-scale processing units (>100 cattle). The variation in farm sizes allowed for a comprehensive analysis of waste management practices and business models across different operational contexts. Data collection was carried out over three months, from September to November 2024, providing ample time for in-depth interviews, field observations, and secondary data collection.

Data Types and Sources

To ensure a thorough and multidimensional understanding of the organic fertilizer value chain, this research utilized both primary and secondary data sources. Primary data were gathered through in-depth interviews, field observations, and documentation. Key informants were purposefully selected to represent various stakeholders across the value chain, including small- and medium-scale farmers, large-scale processing unit operators, agronomists, distributors, and government officials. Secondary data were sourced from government regulations, technical reports, and peer-reviewed literature on livestock waste management and sustainable business models. Regulatory documents, such as the Indonesian

Ministry of Agriculture Regulation No. 13/2017, provided valuable insights into policy frameworks, while reports from livestock agencies and stakeholder workshops (e.g., Focus Group Discussions by Propaktani) enriched the analysis with practical and contextual perspectives.

Data Collection Methods

A combination of qualitative methods was employed to capture the complexities of the organic fertilizer value chain:

- In-Depth Interviews: Semi-structured interviews were conducted based on frameworks such as the Business Model Canvas (BMC), Value Chain Analysis, and PESTEL. Questions focused on waste management practices, existing business models, and challenges faced by stakeholders.
- Field Observations: Direct observations were carried out to document operational processes, technological applications, and waste management practices across different farm scales. Observations covered key activities such as waste collection, biogas production, composting, and product distribution. These insights helped identify inefficiencies and potential optimization opportunities, such as gaps in waste collection systems or underutilized processing capacities.
- Document Analysis: Secondary data were analyzed from regulatory documents, technical reports, and stakeholder workshop outputs. These documents provided a broader industry perspective, highlighting national policies, technological advancements, and market trends. For example, regulatory documents clarified compliance requirements for organic fertilizer certification, while workshop discussions revealed stakeholder priorities and collaborative initiatives.

Data Analysis

A multiple case study approach was employed to analyze the data, integrating three key analytical frameworks: Business Model Canvas (BMC), Value Chain Analysis, and PESTEL Analysis.

- Business Model Canvas (BMC): The nine components of the BMC—value propositions, customer segments, revenue streams, key activities, key resources, key partners, cost structure, channels, and customer relationships—were mapped for each farm scale. This analysis identified gaps and optimization opportunities, such as the need for diversified revenue streams in small-scale operations or improved technology integration in medium-scale farms.

- Value Chain Analysis: Activities throughout the organic fertilizer value chain, from waste collection to product distribution, were assessed to evaluate efficiency, cost structures, and value addition. The analysis revealed, for example, that small-scale farmers often lacked access to efficient waste collection systems, while large-scale units faced logistical and distribution challenges.
- PESTEL Analysis: External factors influencing the industry were examined using stakeholder input and secondary data. Political factors included government policies on waste management and renewable energy incentives, while economic factors encompassed market demand for organic fertilizers and investment costs for processing technologies. Social factors considered community acceptance of biogas and fertilizer products, whereas technological factors highlighted advancements in processing equipment. Environmental considerations addressed emission reductions and resource conservation, while legal factors focused on compliance with SNI certification and environmental regulations.

Data synthesis was conducted using geometric mean scoring to prioritize key drivers and validate findings across different farm scales. Qualitative insights were cross-validated with quantitative metrics, such as waste processing capacity (tons/day) and financial indicators (e.g., payback period, internal rate of return [IRR]). This triangulation ensured the reliability and validity of the study's conclusions, aligning with the broader discussion presented in this research.

RESULTS AND DISCUSSION

Business Model Canvas for Cattle Farm Waste Processing

The sustainable business model for organic fertilizer in this research was developed based on a comprehensive analysis of three scales of cattle farming operations in Bogor and Cianjur Regencies. Researchers conducted an analysis of existing business models and an assessment of internal-external factors as an initial stage that became the foundation for designing the sustainable model. The analysis results revealed significant disparities in waste management capabilities and operational efficiency across different scales of operations. These disparities indicated the need for an integrated business model that could optimize cattle farm waste management. Based on these findings, researchers then developed a sustainable business model canvas for transforming cattle farm waste into organic fertilizer.

The model is structured as follows:

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segmen</th></tr>
<tr>
<td rowspan="3">- Supplier farmers
- Horticultural & organic farming groups
- Accredited laboratories
- SNI certification bodies
- Local government
- Financial institutions/ investors
- Agricultural input distributors</td>
<td>Production:
- Scheduled collection & transportation (25 tons/day)
- Integrated biogas-fertilizer processing
- Strict quality control
- Continuous quality monitoring

Marketing & Sales:
- Technical assistance for product application
- Multi-product distribution system management
- Promotion & digital marketing
- Sales of solid fertilizer, liquid fertilizer, and biogas</td>
<td rowspan="3">- Premium liquid organic fertilizer
- SNI solid organic fertilizer (C-organic >15%)
- Communal biogas (22.8% CH4)
- Quality assurance (internal & external labs)
- Timely distribution system
- Technical application assistance</td>
<td>- Solid-based waste purchase contracts
- Structured farmer assistance program
- Application result monitoring system
- Biogas user community within 500m radius
- Flexible payment schemes
- Technical support</td>
<td rowspan="3">Primary Market:
- Horticultural farmers
- Certified organic farmers
- Medium-large scale plantations

Secondary Market:
- Household biogas users
- Waste supplier farmers
- Urban farming</td>
</tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr>
<td>- Processing facility
- Accredited testing laboratory
- Technical team
- Logistics system</td>
<td>- Direct selling
- Agricultural distributor network
- Digital marketing platform
- Agricultural promotional media</td>
</tr>
<tr><th colspan="2">Cost Structure</th><th colspan="3">Revenue Streams</th></tr>
<tr>
<td colspan="2">Fixed Cost (30%):
- Permanent team salaries & maintenance
- Facility depreciation

Variable Cost (70%):
- Raw materials (solid basis)
- Transportation & handling
- Utilities & processingr
- Packaging & contract labor</td>
<td colspan="3">Primary Revenue (95,3%):
- Premium liquid fertilizer

Secondary Revenue (4,7%):
- SNI solid fertilizer
- Communal biogas</td>
</tr>
</table>

Figure 1.
Sustainable BMC of Dairy Cattle Waste Organic Fertilizer

Indonesian Interdisciplinary Journal of Sharia Economics (IIJSE)
e-ISSN: 2621-606X
Vol. 8. No. 2 (2025)
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Key Partners

The sustainability and efficiency of the business model are supported by a strong network of key partners. These include supplier farmers who provide raw materials with a standardized 30% solid content, horticultural and organic farming groups that participate in a circular economy model as both suppliers and consumers, accredited laboratories for quality assurance, SNI certification bodies for product validation, local governments for licensing and policy support, financial institutions for capital funding, and agricultural input distributors for market expansion. This interconnected partnership ecosystem strengthens the entire value chain, from waste collection to product distribution. Research by Waari et al. (2018) suggests that such strategic collaborations can enhance customer retention by up to 85% and drive a 40% increase in repeat purchases. By engaging these key stakeholders, the model ensures a stable raw material supply, regulatory adherence, and broader market access.

Key Activities

The business model focuses on optimizing the entire operational process, from waste collection to product distribution. As illustrated in Figure 2, core activities include scheduled waste collection (25 tons/day), biogas and fertilizer processing through fermentation and composting, rigorous quality control using both internal and external laboratory testing, and targeted marketing initiatives such as technical assistance and digital promotions.

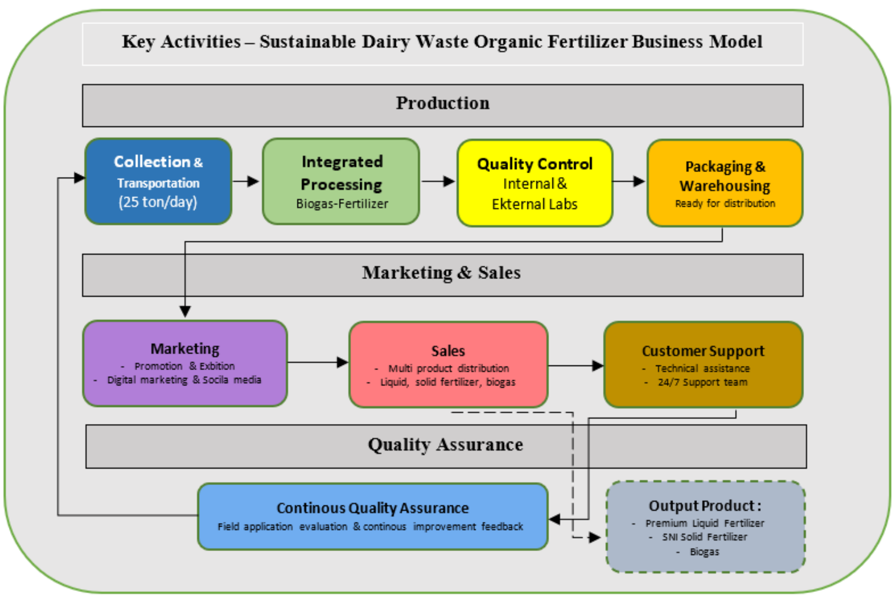

Figure 2.
Key Activities of Sustainable Dairy Cattle Waste Organic Fertilizer Business Model

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Li et al. (2016) highlight that an effective waste collection system can enhance raw material quality by up to 40% while simultaneously reducing logistics costs by 35%. Furthermore, the integrated processing technology implemented in this model, as observed by Chen et al. (2008), optimizes raw material utilization efficiency by as much as 85%. Maintaining consistent quality in organic fertilizer production is essential, as emphasized by Bernal et al. (2009), requiring continuous monitoring throughout the process. To support these operations, the system employs specialized waste collection fleets and a robust digital platform for real-time monitoring and evaluation, ensuring efficient workflows and high-quality outputs.

Key Resources

To ensure effective operations, the business model relies on several critical resources. These include a 3-hectare processing facility equipped with fixed dome biodigesters and aeration systems, integrated processing technologies, a certified technical team consisting of 15 permanent employees and 8–10 contract workers, a logistics system featuring two dump trucks and two operational vehicles, and a digital management platform for real-time monitoring and evaluation. According to Rupf et al. (2017), the availability of integrated facilities can enhance process efficiency by up to 70%. These resources serve as the foundation of the business model, ensuring smooth and sustainable operations at every stage. The combination of advanced infrastructure, skilled human resources, cutting-edge technology, and an efficient logistics system enables the model to achieve its sustainability objectives while maintaining operational excellence.

Value Propositions

The business model delivers value by addressing the needs of diverse customer segments while converting livestock waste into high-value products. These offerings include SNI-certified solid organic fertilizer with an organic carbon content exceeding 15%, premium liquid fertilizer with optimal nutrient balance, communal biogas providing renewable energy to local communities, strict quality assurance through internal and external laboratory testing, an efficient distribution system ensuring product availability, technical support for proper application, and integrated waste management solutions. Research by Oktaviani and Raharjo (2024) suggests that prioritizing premium products can boost profitability by up to 40%. Through these value propositions, the model not only promotes sustainable agriculture but also serves as a scalable and replicable framework for integrated waste management initiatives. This approach aims to increase organic fertilizer adoption, minimize environmental pollution, and generate social benefits for local communities.

Customer Relationships

The model implements strategic customer relationship initiatives to foster long-term engagement and loyalty. These include waste purchase agreements based on solid content, farmer assistance programs to ensure proper product application, performance monitoring systems that provide empirical data on product effectiveness, biogas user communities that serve as real-world demonstrations within a 500-meter radius, flexible payment schemes to enhance accessibility, and 24/7 technical support for customer convenience. Waari et al. (2018) found that such strategies can improve customer satisfaction by up to 85%. By nurturing strong relationships, the model enhances customer retention and encourages repeat purchases. This is particularly crucial in the agricultural sector, where product performance directly influences farmers' livelihoods and long-term trust in sustainable solutions.

Channels

The business model employs multiple channels to effectively reach its target markets. These include direct sales to farmer groups to provide personalized service, agricultural distributor networks to expand market reach, communal biogas piping systems for controlled and efficient distribution, digital platforms for marketing, education, and product usage monitoring, demonstration plots showcasing product effectiveness, and agricultural promotional media to raise awareness and educate consumers. Fournier (2018) suggests that integrating direct sales with distributor networks can improve market penetration by up to 45% while optimizing marketing costs. By utilizing these diverse channels, the model ensures that products are readily available to customers, enhancing convenience and overall impact.

Customer Segments

The business model primarily serves two key customer segments: intensive horticultural farmers who require consistent access to high-quality fertilizers and certified organic farmers who prioritize environmentally friendly agricultural inputs. Additionally, medium-to-large-scale plantations represent a major segment due to their structured purchasing patterns and capacity to absorb large product volumes. Secondary customer segments include households utilizing biogas within a 500-meter radius to maximize social benefits, supplier farmers engaged as development partners, and urban farming initiatives, which, according to Roubík and Mazancová (2020), are growing at an annual rate of 25%. Chen et al. (2022) highlight that horticultural and organic farmers demonstrate high brand loyalty when quality and service consistency are maintained. By targeting these segments, the model aims to drive economic and social impact while fostering sustainable agricultural practices.

Cost Structure

The cost structure of the business model consists of fixed and variable costs. Fixed costs, accounting for 30% of total expenses, include salaries for permanent staff (IDR 1.32 billion per year) and facility depreciation (IDR 552.5 million per year). Variable costs, which constitute 70% of total expenses, encompass raw material procurement based on solid content (IDR 270 million per year), transportation and handling (IDR 1.57 billion per year), utilities and processing (IDR 894 million per year), and packaging and contract labor (IDR 490 million per year). Martinez-Sanchez et al. (2016) suggest that maintaining fixed costs below 35% is ideal for medium-scale waste processing operations. This cost structure is designed to achieve breakeven within 12 months of operation while maintaining an operating margin of 25–30%, ensuring long-term financial sustainability.

Revenue Streams

The business model generates revenue primarily from premium liquid fertilizer sales, which account for 95.3% of total income, contributing IDR 20.25 billion annually. Additional revenue sources include SNI-certified solid fertilizer sales (IDR 877.5 million per year) and communal biogas services (IDR 117.63 million per year), leading to a total annual revenue of IDR 21.24 billion. According to Oktaviani and Raharjo (2024), prioritizing premium products significantly enhances profitability. This revenue strategy is projected to yield a return on investment (ROI) of 25–30% annually, with an expected growth rate of 15–20% in the first three years. By diversifying its revenue streams, the model ensures financial stability and maximizes returns for stakeholders.

Central Processing Unit (CPU) Business Model

Through an in-depth analysis, this study developed a Central Processing Unit (CPU) business model capable of processing 25 tons of livestock waste per day, integrating waste management across three different farm scales.

The CPU model is structured to optimize the entire operational flow from waste collection to final product distribution. A scheduled collection system is implemented, utilizing dedicated fleets equipped with tracking technology to ensure efficiency. Quality control is rigorously maintained, with internal laboratories conducting routine assessments of critical parameters such as moisture content, organic carbon levels, and the C/N ratio, in compliance with SNI Organic Fertilizer standards.

The production process combines biogas technology (fixed dome system) with composting methods (windrow system with mechanical aeration) to produce three key outputs: solid organic fertilizer (1.875 tons per day), premium liquid organic fertilizer (18.75 tons per day), and communal biogas (65.35 m^3 per day). This model effectively integrates waste from farms of different scales through tailored mechanisms: small-scale farms receive financial incentives for supplying waste, medium-scale farms utilize biogas for their own energy needs while transferring surplus waste, and large-scale farms enhance their processing efficiency by optimizing previously underutilized capacity. By facilitating this integration, the CPU model addresses a key challenge: small farms often struggle with waste processing due to limited resources, while large processing units frequently operate below capacity. This synergy ensures more effective waste utilization while enhancing sustainability and economic viability across all farm scales.

Investment Projection Analysis

Projected Net Cash Flow

A financial projection was carried out to assess the net cash flow and overall viability of the Central Processing Unit (CPU) business model, which has a daily processing capacity of 25 tons of cattle farm waste.

The initial investment required for this model is estimated at IDR 11.5 billion, allocated across three main components: basic infrastructure (IDR 4.5 billion), processing technology (IDR 5.5 billion), and transportation-logistics systems (IDR 1.5 billion). Net profit estimations were derived by calculating annual revenue while deducting operational costs, taxes, and depreciation. Depreciation was projected at a fixed rate of IDR 552.5 million per year over a 10-year operational period. Additionally, profit growth is expected to increase by 3.5% annually during the first three years, in line with inflation rate assumptions.

Table 1.
Projected Net Cash Flow for the CPU Business Model with References to Initial Investment Allocation and Operational Cost Assumptions

Description	Year I	Year Ii	Year Iii
Profit Projection	IDR 11,533,049,062	IDR 11,935,705,789	IDR 12,353,455,492
Depreciation	IDR 552,500,000	IDR 552,500,000	IDR 552,500,000
Interest (1-tax%)	IDR 1,500,000,000	-	-
Proceed	IDR 12,085,549,062	IDR 12,488,205,789	IDR 12,905,955,492

The projected net cash flow suggests that the CPU business model can generate substantial revenue starting from its first year of operation, with total earnings amounting to IDR 12.08 billion after factoring in depreciation and loan interest.

Payback Period Calculation

The payback period was analyzed to estimate the time needed to recover the initial investment of IDR 11.5 billion. Based on the projected net cash flow, the investment is expected to break even in less than one year (0.997 years or approximately 12 months). This timeframe is considerably shorter than the standard feasibility benchmark of three years, demonstrating a swift return on investment.

Table 2.
Payback Period Calculation for the CPU Business Model with References to Cumulative Cash Flow Analysis

Years	Proceed (IDR)	Cumulative Proceed (IDR)
1	12,085,549,062	12,085,549,062
2	12,488,205,789	24,573,754,851

Net Present Value (NPV), Profitability Index (PI), and Internal Rate of Return (IRR)

The NPV, PI, and IRR calculations were performed using a 10% discount rate, representing the risk level associated with the biogas industry. The IRR estimation was based on an assumed range of 3% to 10%.

IRR Calculation Formula:

IRR Formula:

$IRR=3\%+ (NPV3\% - NPV\ 10\%)NPV\ 3\% \times(10\% - 3\%)$

$IRR=3\%+ (59{,}392{,}446{,}530-(-532{,}973))\ 59{,}392{,}446{,}530 \times 7\%$

$IRR=100.3\%$

The result indicates exceptionally high profitability, demonstrating the strong financial viability of the business model.

Table 3.
Financial Feasibility Indicators for the CPU Business Model with References to Discounted Cash Flow Analysis

Metric	Value	Standard	Status
Initial Investment	IDR 11,500,000,000	-	-
NPV (10%)	IDR 59,392,446,530	> 0	Feasible
PI (10%)	6.16	> 1	Feasible
IRR	100.3%	> 10%	Feasible

The analysis reveals a positive NPV of IDR 59.39 billion at a 10% discount rate, a Profitability Index (PI) of 6.16 (greater than 1), and an Internal Rate of Return (IRR) of 100.3% (exceeding 10%). These indicators confirm the strong financial viability of the CPU project.

Sustainability Aspects of the Business Model

The proposed business model incorporates three fundamental dimensions of sustainability: economic, environmental, and social. From an economic standpoint, the model ensures long-term profitability by diversifying revenue streams and optimizing operational efficiency. Product diversification plays a crucial role in enhancing business resilience, as Nahed et al. (2019) highlight that diversified outputs help waste processing units withstand market fluctuations. This approach not only stabilizes income but also maximizes resource utilization, ensuring sustained financial viability throughout the project's lifecycle.

In terms of environmental sustainability, the model applies a zero-waste concept in livestock waste management. By utilizing an integrated processing system, it significantly reduces greenhouse gas emissions. Research by Yuvaraj et al. (2021) indicates that such systems can lower emissions by up to 60% compared to conventional disposal methods. This demonstrates the model's contribution to climate change mitigation while promoting eco-friendly waste management practices.

From a social perspective, the business model benefits local communities by increasing farmers' income through a waste purchasing system based on solid content. Latif et al. (2023a) suggest that this mechanism can boost farmer earnings by 15-20%, providing a clear financial incentive for participation. Additionally, the model generates employment for 23-25 individuals from surrounding communities, fostering local economic growth and improving social well-being. By integrating these three dimensions, the business model ensures financial stability, environmental responsibility, and social inclusivity, making it a holistic and sustainable solution.

Discussion

This study developed a sustainable business model for producing organic fertilizer from cattle farm waste using the Business Model Canvas (BMC) framework. The Central Processing Unit (CPU) model, designed with a 25-ton/day processing capacity, was formulated through an in-depth analysis of existing business conditions at three different operational scales. It also incorporated internal insights from value chain analysis and external influences identified using PESTEL analysis, ensuring that the model remains contextually relevant and adaptable to various operational settings.

The proposed business model integrates the nine key components of BMC, all of which work synergistically while aligning with the triple bottom line (profit, planet, and people) sustainability approach. The value propositions—which include solid organic fertilizer, premium liquid fertilizer, and biogas—are marketed to a diverse range of customer segments, such as horticultural farmers, organic farmers, and plantation owners, through integrated distribution channels. This diversification strategy not only enhances revenue generation but also strengthens the business's resilience against demand fluctuations.

A feasibility analysis highlights the strong economic potential of the CPU model, featuring a payback period of just 12 months and an Internal Rate of Return (IRR) of 100.3%. These financial indicators confirm the model's ability to generate substantial returns while maintaining efficient operations. Beyond economic viability, the model also addresses critical environmental challenges, achieving a 60% reduction in greenhouse gas emissions, thereby supporting climate change mitigation. On a social level, the initiative generates employment opportunities for 23–25 local workers, contributing to economic growth and improving community well-being.

However, the success of this business model depends on several critical factors. First, government support—such as subsidies for renewable energy, tax incentives for organic fertilizer producers, and regulations promoting sustainable waste management—is essential for reducing operational risks and enabling scalability. Second, forming strategic partnerships with stakeholders, including local farmers, agricultural cooperatives, and private investors, ensures a stable supply of raw materials and helps expand market access. Third, investing in capacity-building programs to enhance the technical expertise and operational skills of local workers is crucial for the long-term sustainability of the CPU model. In conclusion, this business model not only provides an innovative solution to livestock waste management but also contributes to broader goals of environmental sustainability, economic growth, and social development. By integrating economic, environmental, and social dimensions, the model serves as a scalable and replicable framework for waste-to-resource initiatives in rural and peri-urban areas. Future research should explore its expansion to larger regions and adaptability to other types of agricultural waste to maximize its impact.

CONCLUSION

This research has successfully designed a sustainable business model for the organic fertilizer industry based on cattle farm waste in accordance with the research objective. The Central Processing Unit (CPU) model, designed with a capacity of 25 tons/day, effectively addresses the processing capacity gap between different scales of cattle farming operations and maximizes value creation from waste. The sustainability aspects of the model are manifested in three dimensions: economic, through strong financial viability (12-month payback period, 100.3% IRR on an IDR 11.5 billion investment) and multiple revenue streams; environmental, with emission reduction of up to 60%; and social, through the creation of 23-25 jobs and increased farmer income. The successful design of this business model offers an integrated solution that can be replicated for circular economy development in agricultural waste management across various contexts.

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