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From Waste to Assets through Value Creation Strategies in Goat Farming

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ABSTRACT

This study examines the transformation of livestock waste into economic and environmental value through innovation in goat farming. The study applies a qualitative case study approach using observation, interviews, and documentation of a Smart Composting System. The system utilizes leftover fermented corn-stalk and leaf silage, goat manure, horse manure, EM4, and brown sugar, supported by Internet of Things (IoT)-based monitoring of temperature, moisture, and NPK. The findings indicate that the innovation enables organic waste to be transformed into compost while generating operational data that can support more effective management decisions. The integration of environmental accounting further enables the identification of processing costs, potential economic value, and environmental benefits. The study demonstrates that waste management can be repositioned from a cost-oriented activity into a value creation strategy through the integration of resource recovery, digital technology, and environmental-economic measurement. The proposed approach provides a practical foundation for developing circular and sustainable business practices in goat farming.

Keywords: Goat Farming; Waste Valorization; Value Creation; Circular Economy; IoT

Field: Business Administration; Sustainable Business; Circular Economy; Business Innovation

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SDGs: Decent Work and Economic Growth (8); Industry, Innovation and Infrastructure (9); Responsible Consumption and Production (12); Climate Action (13); Life on Land (15)

INTRODUCTION

Goat farming plays an important role in supporting rural livelihoods, household income, and local agricultural economies (Assan N, 2025). Beyond the production of meat and other livestock products, goat farming generates substantial organic residues, including manure and leftover feed. These residues are often treated primarily as waste rather than as productive resources. When poorly managed, accumulated organic waste can create unpleasant odors, reduce environmental quality, and increase the cost of farm management. At the same time, the same materials contain organic matter and nutrients that can potentially be transformed into products with economic value.

This situation creates an opportunity to shift livestock waste management from a disposal-oriented approach toward value creation (Wang & Tao, 2020). The circular economy perspective emphasizes keeping resources in productive use for as long as possible and recovering value from materials that would otherwise be

discarded (Terpou et al., 2025). In goat farming, the conversion of organic residues into compost provides a practical pathway for creating additional value while reducing environmental pressure. However, realizing this potential requires more than simply processing waste. Farmers need an approach that can improve the efficiency of waste utilization, monitor the processing conditions, assess production costs, and identify the economic value generated from the resulting product.

Technological innovation provides an opportunity to strengthen this transformation (Khan et al., 2025). The development of a Smart Composting System integrates composting with Internet of Things (IoT)-based monitoring of temperature, moisture, and nutrient conditions. The system enables composting processes to be monitored using data rather than relying solely on visual observation or farmers' experience. Furthermore, integrating environmental accounting allows the economic and environmental consequences of waste management to be documented, including processing costs, potential compost value, and environmental benefits. Thus, technology can connect the physical transformation of waste with managerial information required for value creation.

From a business administration perspective, this transformation is important because waste management can become part of the firm's value creation strategy rather than merely an environmental obligation (Gull et al., 2022). Waste that previously generated handling costs can become an input for compost production, while digital monitoring can provide information for improving operational efficiency and decision-making. This creates a potential pathway in which waste is transformed into a productive asset, simultaneously generating economic and environmental value.

Based on this context, this study examines From Waste to Assets through Value Creation Strategies in Goat Farming. The study focuses on how innovation in organic waste management can support value creation in goat farming by integrating waste utilization, digital monitoring, operational efficiency, and environmental value measurement. The study is expected to contribute to the discussion of sustainable business innovation by demonstrating how agricultural waste can be repositioned from a cost burden into a strategic resource for creating economic and environmental value.

LITERATURE REVIEW

Circular Economy and Value Creation

The circular economy represents a shift from the conventional linear model of take–make–dispose toward systems that retain materials and resources within productive cycles (Islam et al., 2024). In agriculture, this approach emphasizes the reuse, recovery, and valorization of biomass and agricultural by-products rather than treating them solely as waste (Kirchherr et al., 2023). Recent literature highlights that circular agriculture can improve resource efficiency by reconnecting waste streams with production processes and creating new economic and environmental value (Renaldo, Fransisca, Junaedi, Augustine, et al., 2025).

From a business perspective, circularity is not limited to reducing environmental impacts. It can also become a source of value creation (Renaldo & Fransisca, 2024), particularly when waste materials are transformed into marketable products, productive inputs, or new business opportunities. Agricultural waste valorization can therefore generate additional revenue streams while reducing waste-management costs. Previous reviews identify business models, stakeholder collaboration, appropriate technologies, and supply-chain integration as important conditions for successfully transforming agricultural waste into value (Renaldo, Fransisca, Junaedi, Suhardjo, et al., 2025).

In livestock systems, this perspective is particularly relevant because manure and other organic residues can be transformed into fertilizers, bioenergy, and other value-added products. Recent research describes livestock manure as a potential resource within a circular economy rather than merely a waste stream, while emphasizing the importance of appropriate technologies and coordination among stakeholders.

Livestock Waste Valorization

Livestock waste management has traditionally focused on reducing environmental and health risks associated with accumulation, odor, pathogens, and emissions (Martinez et al., 2009). However, contemporary approaches increasingly emphasize waste valorization, whereby organic residues are converted into useful resources. Composting, nutrient recovery, anaerobic digestion, and other biological processes can transform livestock residues into fertilizers, energy, and other products with economic value (Renaldo et al., 2024).

The economic significance of this transformation is important for livestock businesses. Properly managed manure can become an input for agricultural production and potentially reduce dependence on externally purchased fertilizers. At the same time, waste conversion can create additional products and revenue opportunities.

Research on livestock manure biorefineries shows that the economic and environmental performance of waste recovery depends on technology selection, operating costs, feedstock characteristics, and the ability to utilize the resulting products.

For goat farming, this perspective creates an opportunity to reposition manure and leftover feed from cost-generating waste into productive assets. Such a transformation requires not only a technical process for converting organic materials but also a managerial framework that evaluates costs, benefits, resource efficiency, and potential market value (Putri et al., 2022).

Technological Innovation and Smart Livestock Management

Digital technologies have increasingly changed how agricultural and livestock businesses manage operational processes (Junaedi et al., 2026). Internet of Things (IoT) technologies enable physical objects and equipment to collect, transmit, and exchange data, supporting monitoring and decision-making in agricultural environments. Research on smart livestock systems shows that IoT can support monitoring, control, and tracking functions and can contribute to more data-driven livestock management.

More recent research has extended the application of IoT toward environmental management in animal farming. IoT-based environmental control can support the monitoring and management of environmental conditions and has potential to improve emission management and sustainability performance.

Within waste management, the managerial value of IoT lies not simply in the presence of sensors but in its ability to convert operational conditions into usable management information (Prihastomo et al., 2026). In a smart composting system, temperature, moisture, and nutrient information can be continuously monitored, allowing operators to identify changes in the composting process and make more informed operational decisions. Consequently, IoT can serve as an enabling technology for improving operational efficiency and strengthening the evidence base for value creation.

Environmental Management and Business Value

Environmental management is increasingly connected with business performance because environmental resources, waste, energy, and emissions can generate direct and indirect economic consequences (Voinea et al., 2020). Environmental management accounting provides a managerial mechanism for identifying and evaluating environmental-related costs and physical resource flows, thereby helping organizations incorporate environmental considerations into business decisions.

The integration of digital technologies with environmental accounting offers an opportunity to make environmental information more timely and operationally useful. Recent research on digital green management accounting indicates that accounting and digital technologies can support the implementation of circular economy principles, although managerial accounting mechanisms for operationalizing circular initiatives remain relatively underexplored.

In the context of goat farming, environmental accounting can therefore extend waste management beyond the question of "how much waste is produced?" toward questions such as "how much does waste management cost?", "what economic value can be recovered?", and "what environmental benefits are generated?" This creates a stronger connection between environmental management and business strategy (Fransisca et al., 2025).

Waste-to-Value Strategy in Goat Farming

The integration of circular economy principles, waste valorization, digital technology, and environmental management suggests that livestock waste can become part of a broader value creation strategy (Mata et al., 2026). Instead of treating waste management as an isolated environmental activity, farms can integrate waste recovery into their operational and business models.

For goat farming, the transformation of leftover feed and manure into compost represents a relatively accessible circular pathway. Crop residues and livestock waste can be returned to agricultural production through organic fertilizer, creating a closed-loop relationship between livestock and crop systems. Research on integrated crop-livestock systems in Indonesia similarly emphasizes composting, vermicomposting, fermentation, and manure upgrading as pathways for creating more circular agricultural systems.

The introduction of smart monitoring can further strengthen this process by providing data on the biological and operational conditions of composting. Meanwhile, environmental accounting can translate these physical processes into economic information. The resulting framework can be represented as:

Organic Waste → Resource Recovery → Digital Monitoring → Environmental-Economic Measurement → Value Creation

This perspective shifts the strategic position of waste management from a cost center toward a potential value-generating activity.

Research Gap

Although previous studies have extensively discussed circular agriculture, livestock manure valorization, smart farming, and environmental sustainability, these streams of research are often examined separately. Studies on livestock waste tend to emphasize technological conversion and environmental benefits, while studies on IoT focus on monitoring and operational efficiency. Meanwhile, circular economy research emphasizes resource recovery and new value streams.

A more integrated perspective is therefore needed to explain how technological innovation can transform livestock waste into an economically meaningful asset. In particular, limited attention has been given to connecting IoT-based waste monitoring with environmental-economic measurement and value creation at the farm-business level.

This study addresses that gap by examining goat farming waste management as a value creation strategy, rather than solely as an environmental management problem. The study positions smart composting as an organizational and business innovation that connects waste valorization, digital technology, operational efficiency, and environmental-economic value. This perspective provides a basis for understanding how small and medium-scale goat farms can develop circular business practices while simultaneously improving resource utilization and creating additional economic value.

Conceptual Framework

The literature supports the following conceptual logic:

Waste Management Innovation

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IoT-Based Process Monitoring

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Operational Efficiency & Resource Recovery

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Environmental-Economic Measurement

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Value Creation

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Sustainable Goat Farming Business

This framework makes the article much more suitable for a Business Administration journal, because the central question becomes not merely whether the technology works, but how innovation changes the way a livestock business creates and captures value from previously underutilized resources.

METHODOLOGY

This study employed a qualitative case study approach to examine how waste management innovation can create economic and environmental value in goat farming (Creswell & Creswell, 2018). The study was conducted in a goat farming context where leftover feed and livestock manure were processed through a Smart Composting System. The research focused on understanding the transformation of organic waste from a disposal burden into a productive resource and its implications for business value creation.

Data were collected through direct observation, semi-structured interviews, and documentation. Observations focused on the existing waste management practices, composting activities, and implementation of the smart composting prototype. Interviews were conducted with farm managers, farmers, and relevant stakeholders to explore perceptions of operational efficiency, usability, economic benefits, environmental benefits, and opportunities for further adoption. Documentation included records of waste inputs, composting activities, monitoring data, and information related to processing costs and potential economic value.

The smart composting process utilized leftover fermented corn-stalk and leaf silage, goat manure, horse manure, EM4, and brown sugar as the main materials. The process was supported by IoT-based monitoring of temperature, moisture, and nutrient parameters (NPK). The collected information was used to understand the relationship between composting conditions, resource utilization, and potential value creation.

Data were analyzed thematically by identifying recurring patterns related to waste utilization, technological innovation, operational efficiency, economic value, environmental benefits, and business opportunities. The analysis then connected these themes to the circular economy perspective to explain how waste can be transformed into a productive asset. The resulting analytical framework emphasizes the process of waste transformation → resource recovery → digital monitoring → economic and environmental value creation.

The study therefore positions the smart composting system not merely as a waste-processing technology, but as a business innovation that enables goat farms to convert previously underutilized resources into additional economic and environmental value.

RESULTS AND DISCUSSION

Result

Transformation of Livestock Waste into Productive Resources

The development of the Smart Composting System demonstrated that organic residues from goat farming can be repositioned from waste into productive resources. The main materials consisted of leftover fermented corn-stalk and leaf silage, goat manure, and horse manure, supported by EM4 and brown sugar as fermentation inputs. This combination provides an opportunity to utilize materials that would otherwise have limited economic value.

The process represents a shift from a conventional waste disposal approach toward resource recovery. Instead of accumulating or discarding leftover feed and manure, the materials are processed into compost that can potentially be used within agricultural activities or developed as a marketable organic fertilizer. From a business perspective, this transformation reduces the perception of waste as a cost burden and creates the possibility of an additional value stream.

Digital Innovation in Waste Management

The integration of IoT represents an important innovation in the composting process. The prototype incorporates monitoring of temperature, moisture, and NPK, allowing the composting process to be observed through digital data rather than relying solely on visual inspection or farmer experience. This creates a more data-driven approach to operational management. Information generated during the composting process can support decisions regarding process conditions and subsequent treatment. The dashboard also provides a more accessible way for users to understand the condition of the composting process.

The significance of this finding from a business administration perspective is that digital technology is not being used merely as an additional technical component. It functions as a management information mechanism that connects operational activities with decision-making.

Value Creation through Waste Management Innovation

The most important finding is the emergence of a value-creation pathway from livestock waste management. The system connects three previously separate activities: organic waste processing, digital monitoring, and economic-environmental measurement.

The resulting value creation can be described as:

Waste → Processing → Monitoring → Resource Recovery → Economic and Environmental Value

This pathway demonstrates that innovation in waste management can contribute to business strategy. Composting can create potential economic value through the utilization or sale of compost, while the reduction of unmanaged waste provides environmental benefits. At the same time, digital monitoring generates information that can support more efficient management. Thus, the innovation changes the position of waste management from a predominantly cost-oriented activity into a potential value-generating activity.

Environmental Accounting as a Value Measurement Mechanism

The integration of environmental accounting further strengthens the business relevance of the innovation. Rather than measuring success only by the quantity of compost produced, the system introduces the possibility of assessing processing costs, potential economic value, and environmental benefits.

This approach provides a broader understanding of business performance. The economic value of compost can be considered together with the costs avoided through improved waste management and the environmental benefits generated by reducing unmanaged organic waste.

Consequently, environmental information can become part of managerial decision-making. This is particularly relevant for small and medium-scale livestock businesses, where environmental activities are often viewed as additional costs rather than components of business value.

Discussion

The findings indicate that the Smart Composting System represents more than a technological improvement in compost production. It constitutes a business process innovation because it changes how farm resources are managed and how value is generated from previously underutilized materials.

The combination of circular economy principles and digital technology creates a closed-loop approach in which waste from livestock production becomes an input for another productive activity (Nassar, 2026). The use of IoT strengthens process visibility, while environmental accounting provides a mechanism for translating physical waste-management activities into economic and environmental information.

The key managerial implication is that livestock businesses can potentially pursue sustainability without treating environmental management as separate from business performance. Instead, resource efficiency, digitalization, and environmental management can be integrated into a single value-creation strategy.

The study therefore proposes that the transformation from waste to asset occurs through three interconnected mechanisms: resource recovery, data-driven management, and value measurement. This provides a practical foundation for developing circular business models in goat farming and potentially in other small-scale livestock enterprises.

Proposed Value Creation Model

Based on the findings, the study proposes the following model:

Organic Waste

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Smart Composting Innovation

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IoT-Based Monitoring

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Operational Efficiency

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Compost & Resource Recovery

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Economic Value + Environmental Value

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Sustainable Business Value

The model illustrates the central argument of this study: livestock waste becomes an asset when technological innovation enables its recovery, monitoring, and measurement as a source of economic and environmental value.

CONCLUSION

Conclusion

The study concludes that livestock waste management can be transformed from a disposal-oriented activity into a value creation strategy in goat farming. The Smart Composting System integrates organic waste utilization, IoT-based monitoring, and environmental-economic measurement to convert leftover feed and livestock manure into a potentially valuable compost product. This transformation demonstrates that waste can function as a productive asset when supported by appropriate technological and managerial innovation.

Implications

The study provides practical implications for goat farmers by demonstrating an alternative approach to managing organic waste while creating potential additional economic value. For business managers, the integration of IoT and environmental accounting provides information that can support operational decisions and resource efficiency. For policymakers and agricultural stakeholders, the approach offers a potential model for promoting circular economy practices and sustainable livestock businesses.

Limitations

This study focuses on a specific goat farming context and an early-stage Smart Composting System. Therefore, the findings may not fully represent different livestock production systems or farm scales. The study also focuses primarily on the process of waste transformation and potential value creation, while long-term financial performance, market acceptance, and large-scale adoption have not yet been comprehensively evaluated.

Recommendations

Goat farmers are recommended to adopt more systematic waste-management practices and utilize digital monitoring to improve process control. Further development should focus on improving sensor reliability, dashboard usability, compost quality, and the calculation of economic and environmental benefits. Collaboration among farmers, government institutions, universities, and potential business partners is also recommended to support wider implementation.

Future Research

Future research should conduct quantitative validation of the proposed value-creation model by measuring changes in operational efficiency, waste-management costs, compost production, revenue potential, and environmental benefits. Comparative experiments using different waste compositions and fermentation formulations are also needed. Further studies could examine technology adoption, customer acceptance, business model development, and the scalability of smart composting across different livestock enterprises.

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