
Unveiling the Potential of Circular Economy in Cattle Waste Management for Achieving Sustainable and Green Growth

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Abstract

The cattle industry is a key component of the global agricultural economy, and faces significant challenges related to waste management and environmental sustainability. In response to growing concerns over greenhouse gas emissions and resource depletion, this study investigates the potential of circular economy (CE) principles in transforming cattle waste management practices to promote a green economy and sustainable development. This study employs a comprehensive literature review methodology to analyze various strategies for implementing CE approaches in the cattle sector, synthesizing findings from relevant publications. The study aims to identify effective methods for reducing methane emissions, enhancing resource utilization efficiency through biogas and organic fertilizer production, and fostering cross-sectoral integration between livestock and agricultural operations. The results highlight the potential for CE implementation to substantially reduce the environmental footprint of cattle farming while creating new revenue streams. Key challenges include the need for technological infrastructure investment, supportive government policies, and enhanced farmer education. The study concludes that strategic policy interventions are essential to incentivize the adoption of CE practices, promote technological innovation, and ensure the long-term sustainability of the cattle industry. The findings provide actionable insights for policymakers, industry stakeholders, and researchers to foster the transition toward a more resource-efficient and environmentally responsible cattle sector.

Keywords:

Circular Economy, Cattle Waste Management, Green Economy, Sustainable Development

1. Introduction

The cattle farming sector constitutes a cornerstone of the global agricultural economy, supplying essential commodities such as meat, milk, and leather, which collectively underpin food security, nutritional adequacy, and industrial production across diverse socio-economic contexts. Nevertheless, alongside its economic contributions, the sector generates considerable volumes of waste, the mismanagement of which poses profound environmental and public health challenges. Cattle waste is broadly classified into three categories: methane emissions, solid waste, and liquid waste. Methane, produced primarily through enteric fermentation in ruminants, is particularly

concerning due to its significantly higher global warming potential (GWP) compared to carbon dioxide (CO₂). The Food and Agriculture Organization (FAO, 2020) estimates that the global livestock sector accounts for approximately 14.5% of total anthropogenic greenhouse gas (GHG) emissions, with cattle methane emissions constituting the dominant share [1]. More recent findings by [2] suggest that livestock-derived methane accounts for nearly 39% of total global methane emissions, representing a substantial contributor to climate change. The Intergovernmental Panel on Climate Change [3] reports that methane's GWP is 28 times greater than that of CO₂, underscoring its central role in global warming dynamics. Consequently, establishing robust and efficient waste management systems within the cattle sector is imperative for mitigating adverse climate and health outcomes.

Beyond its climatic implications, inadequately managed cattle waste exerts deleterious effects on terrestrial and aquatic ecosystems. Improper disposal of solid manure often results in the leaching of nutrients and pathogens into soil and water bodies, thereby compromising environmental quality and posing significant risks to human health. Such contamination is particularly acute in regions where manure management infrastructure is limited or absent. The World Health Organization [4] warns that livestock-related water pollution can compromise potable water quality, increase the prevalence of zoonotic diseases, and erode food security. Supporting this, data from the United Nations Environment Programme (UNEP, 2021) reveal that approximately 70% of livestock waste in developing economies remains untreated, leading to extensive soil and water degradation. These realities necessitate the urgent adoption of sustainable waste management frameworks, most notably those informed by circular economy principles.

The implementation of a circular economy in the cattle farming sector faces several challenges. A primary obstacle is the high cost associated with efficient waste treatment technologies, coupled with a lack of technical knowledge among farmers. [5] identify that high initial investment costs, infrastructural limitations, and a lack of understanding regarding the long-term economic potential of waste management hinder the adoption of a circular economy in the livestock sector. A KPMG report (2022) suggests that while the livestock sector has considerable potential to reduce operational costs through the circular economy, farmers are often reluctant to invest in new technologies without supportive policies and clear incentives. Governments must formulate policies that encourage investment in environmentally friendly technologies and provide training to farmers on the long-term economic benefits achievable through more efficient waste management.

Adopting a circular economy in the cattle sector not only offers benefits in terms of reducing environmental impact but also holds significant potential to support sustainable development. According to [6], a livestock sector that embraces circular economy principles could reduce its greenhouse gas emissions by up to 30% over 10 years. This demonstrates that the circular economy not only aids in emission reduction but also has the potential to enhance the energy security of the livestock sector through the utilization of biogas. This circular model also yields social benefits, such as the creation of new employment opportunities in the waste processing and biogas production industries, thereby supporting local economies and social sustainability [5]

This study aims to explore the potential application of the circular economy in managing cattle livestock waste to support a green economy and sustainable development. Employing a literature review approach, this study will analyze various strategies for implementing cattle waste management based on circular economy principles. The study will also identify the challenges and

opportunities in implementing the circular economy, as well as its impact on reducing greenhouse gas emissions, enhancing resource use efficiency, and promoting local economic development.

2. Material and Methods

This study employs a qualitative research design with a literature review approach to analyze the application of the circular economy in cattle waste management, aiming to support sustainable development. The secondary data utilized in this study were obtained from relevant books, academic journals, scholarly articles, and government reports. The primary focus of the research is to identify circular economy strategies in cattle waste management and to assess their contribution to greenhouse gas emission reduction, energy resilience, and local economic empowerment.

The data analysis was conducted in three sequential stages. First, data reduction involved selecting and condensing relevant literature to facilitate the categorization of key issues. Second, data presentation, in which the information was organized systematically to support logical interpretation. Third, Conclusion drawing, in which the main findings were synthesized to formulate recommendations for the implementation of circular economy principles in the cattle farming sector.

The literature review method involved retrieving references from both national and international journals through online sources affiliated with Google Scholar. This article is structured into several main sections. The Introduction outlines the background and objectives of the study. The Methodology describes the detailed research procedures. The Discussion is organized into subsections, namely: the concept of the circular economy, its application within the context of sustainable development, the integration of the cattle farming sector with other sectors in advancing the circular economy, and the potential for circular economy-based cattle waste management. The Conclusion summarizes the key discussion points and presents recommendations for practical implementation.

3. Results and Discussion

3.1 The Concept of the Circular Economy in Cattle Waste Management

Circular Economy (CE) is a paradigm within economic systems that emphasizes optimizing resource use through waste reduction and recycling. Contrary to the linear "take, make, dispose" model, the circular economy aims to sustain resources by reusing products, materials, and energy within a closed-loop system [7]. In the context of cattle farming, applying circular economy principles offers potential solutions for livestock waste management that can reduce environmental impacts while creating new economic value.

The core principle of the circular economy, "reduce, reuse, recycle," can be applied to cattle waste management to establish more efficient and environmentally friendly cycles. Cattle waste, including manure and urine, can become a significant source of pollution if not properly managed. Within a circular economy framework, however, such waste can be transformed into high-value resources, including biogas and organic fertilizer, thereby reducing reliance on fossil fuels and synthetic fertilizers [8].

Biogas production is a primary example of circular economy application in cattle waste management, contributing to the reduction of greenhouse gas emissions, particularly methane (CH₄). Methane produced by the decomposition of livestock manure is a greenhouse gas with a

global warming potential roughly 25 times greater than that of carbon dioxide [3]. Treating cattle waste via biogas systems captures and utilizes methane to generate renewable energy, which can substitute fossil fuels in energy production. [9] demonstrate that biogas derived from cattle waste can produce sufficient energy to meet household electricity needs or even supply small-scale industry, thereby substantially lowering carbon emissions.

In addition to biogas, processed cattle manure can be utilized as an organic fertilizer, improving soil quality and supporting sustainable agricultural practices. Using manure-based organic fertilizers can reduce dependence on chemical fertilizers, which are known to have adverse effects on soil health and ecosystems [10]. This approach aligns closely with sustainable development objectives, given the importance of environmentally sound food security and the efficient use of natural resources.

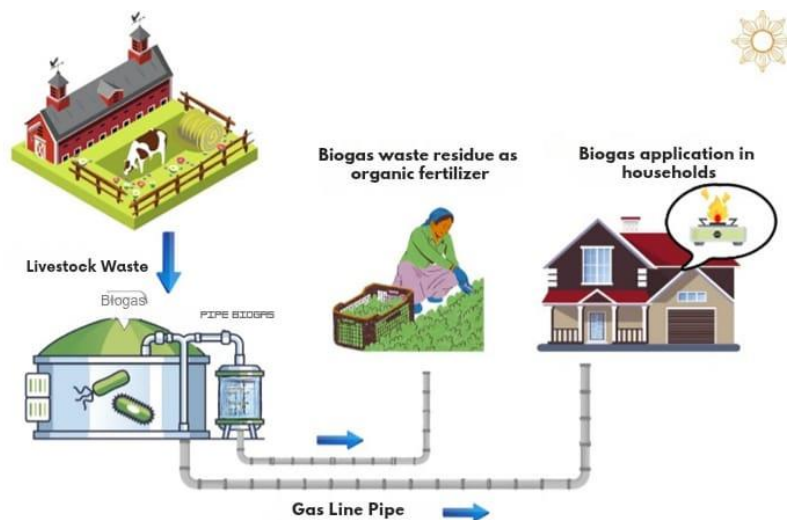


Figure 1

Flow of Livestock Waste Conversion into Biogas

The implementation of a circular economy in the cattle farming sector also offers contributions to local economic empowerment. As a sector that engages millions of small- and medium-scale farmers in developing countries, circular-economy-based livestock waste management can create opportunities for producers to increase their incomes through the generation of renewable energy and the production of organic fertilizer. A study by [11] suggests that the circular economy not only reduces waste but also creates new economic opportunities, enhances local competitiveness, and strengthens economic resilience at the community level.

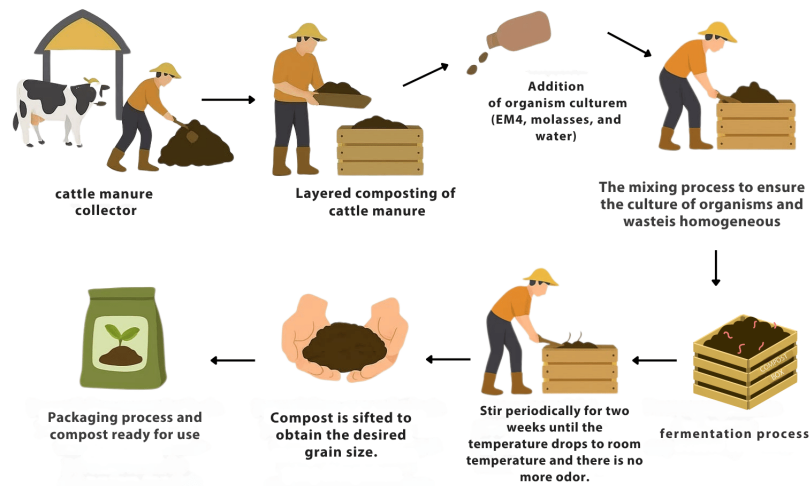


Figure 2

Flow of livestock waste management into organic fertilizer

Through the deployment of appropriate technologies and enabling policies, the application of circular economy principles to cattle waste management can contribute to achieving sustainable development objectives, particularly those related to reducing greenhouse gas emissions, ensuring energy security, and promoting community economic empowerment. Therefore, the cattle farming sector, as one of the most significant contributors to global greenhouse gas emissions [10], possesses significant potential to transition toward more environmentally friendly and sustainable systems.

3.2 Circular Economy in the Context of Sustainable Development

The Sustainable Development Goals (SDGs) were formulated by the United Nations (UN) and adopted in 2015. In total, 17 SDGs are encompassing 169 detailed targets, which provide a holistic roadmap for a better global future. These goals focus on critical issues such as climate change, natural resource management, social and economic justice, and achieving food security, quality education, gender equality, access to clean energy, and global peace. The UN emphasizes that achieving the SDGs requires active engagement from all national governments, while underscoring the importance of private-sector contributions to these efforts [12].

Sustainable development is a concept that stresses achieving a balance among social, economic, and environmental dimensions at the macro level. Within this context, the circular economy (CE) emerges as a micro-level solution focused on the sustainable management of production and consumption processes. Circular economy initiatives, which promote product reuse and waste reduction, are believed to yield superior outcomes in achieving sustainability objectives. The circular economy can thus be regarded as a tool that supports the realization of sustainable development [13].

Circular economy practices demonstrate a significant direct relationship with the attainment of several SDGs. The implementation of CE principles has the potential to make substantial contributions to key SDG targets, particularly SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth), SDG 12 (responsible consumption and production), and SDG 15 (life on land). Recent research shows that circular economy adoption not only supports SDGs related to environmental management but can also drive inclusive and sustainable economic growth [14].

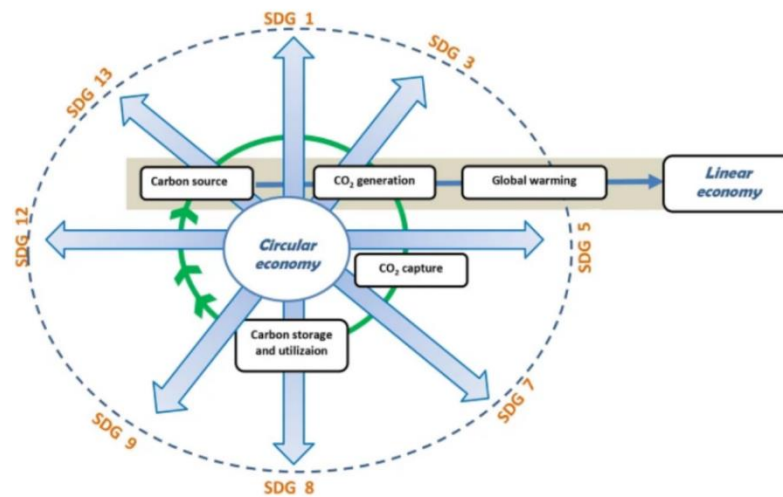


Figure 3

Circular Economy in the Context of Sustainable Development

Source: Gautam et al. (2025)

The circular economy model prioritizes the resilience of natural resources by replacing the linear, single-use production–consumption model. Under this model, products are designed for extended lifespans and ease of repair, disassembly, or recycling. The objective of CE is to prolong product life cycles by facilitating repair, redesign, and reuse, ultimately reprocessing items into raw materials. In doing so, the circular economy emulates principles inherent in sustainable natural systems [12].

Successful implementation of the circular economy can have positive impacts across the three principal dimensions of sustainable development: economic, social, and environmental. Processes of reuse, repair, and remanufacture reduce dependence on virgin raw materials and conserve natural resources. In this regard, the circular economy offers more energy-efficient and resource-efficient solutions compared with conventional recycling approaches that rely on low-quality raw material processing. Accordingly, first-use products should be recovered for reuse or repair and only thereafter processed into feedstock for reproduction [15].

3.3 Cross sector Integration between Cattle Farming and Other Industries to Support Circular Economy Principles

The implementation of a circular economy (CE) in cattle waste management requires robust cross-sector collaboration, particularly between the cattle sector and the agriculture, plantation, forestry, horticulture, and other food crop sectors [16]. Such intersectoral integration is instrumental in forming an effective circular economy network that enables the sustainable reuse and recycling of material and energy flows. The cattle sector functions not only as a component of the biological chain but also as a key element within a broader economic system interconnected with other sectors. Accordingly, utilizing agricultural outputs as livestock feed can reduce feed costs, while livestock waste, such as cattle manure, can be processed into organic fertilizer that benefits the agricultural sector.

According to the most recent data from Statistics Indonesia (BPS), Indonesia’s cattle population in 2021 exceeded 17 million heads, alongside significant developments in the agricultural and plantation sectors. Given a large cattle population and extensive agricultural land, there is substantial potential to manage cattle waste as organic fertilizer to support agricultural productivity, particularly for food crops and plantations. The application of cattle manure as organic

fertilizer has been shown to improve soil quality and crop yields. For example, manure-based fertilizers can increase coffee production by up to 46.56% [17].

Table 1
Cattle Population and Agricultural Land Area in Indonesia (2020–2024)

Year	Cattle Population (heads)	Rice Land Area (ha)	Coffee Plantation Area (ha)	Coffee Production (tons)	Number of Farmers (individuals)
2020	17.100.000	10.000.000	1.200.000	500.000	2.000.000
2021	17.500.000	10.100.000	1.250.000	520.000	2.050.000
2022	17.750.000	10.200.000	1.300.000	540.000	2.100.000
2023	18.000.000	10.300.000	1.350.000	550.000	2.150.000
2024	18.200.000	10.400.000	1.400.000	560.000	2.200.000

Source: bps.go.id

Agricultural waste such as rice straw and coffee husks possesses substantial potential for utilization as alternative feed sources for cattle. Rice straw, which is abundant in many rice-producing regions, has an adequate nutritional value for cattle, although with lower digestibility and protein content compared to other primary feedstuffs. Typically regarded as waste with minimal utilization, rice straw can be further exploited as an additional feed ingredient for cattle. According to research by [18], the abundant rice straw in Indonesia can be utilized for cattle feed, albeit primarily as a supplement within the diet. Similarly, coffee husks, despite their high fiber content, can serve as an alternative feed for ruminants; however, their inclusion in cattle rations should be limited to 20% of the total diet to prevent a decline in feed digestibility by rumen microbes [19].

The utilization of these agricultural and plantation waste materials as livestock feed not only adds value for farmers but also holds the potential to significantly reduce feed costs. Integrating the cattle industry with the agricultural sector can also enhance local food security by ensuring a more stable and economical supply of livestock feed. The use of by-products from agricultural industries as feed ingredients can decrease dependence on imported feeds, which are subject to price volatility and can affect the stability of the livestock economy [18].

It is crucial to recognize that collaboration between the cattle sector and the agricultural and plantation sectors can strengthen both economic and environmental sustainability. Implementing circular economy principles, which reuse waste as valuable resources, not only reduces pollution and conserves natural resources but also offers economic advantages to producers. Production systems that integrate crop cultivation and livestock farming have the potential to create positive ecological interactions, such as improved soil fertility and natural pest control, which collectively aid in preventing environmental degradation and maintaining long-term profitability [20].

The effective integration of agricultural and livestock systems, as proposed within circular economy models, can mitigate adverse environmental impacts by minimizing the use of synthetic chemicals in farming and plantation activities, as well as reducing the amount of unutilized organic waste [20]. Advances in agricultural and livestock technologies, including genetic improvements in crops and animals, as well as soil conservation and fertilization techniques, play a crucial role in the successful implementation of these integrated systems. It is essential for governments to support policies that strengthen this sectoral integration, particularly by providing incentives to farmers and livestock producers to adopt circular economy practices that enhance productivity and welfare.

Collaboration between the cattle industry and the agricultural and plantation sectors in Indonesia holds substantial potential to improve resource efficiency, decrease production costs,

and promote both economic and environmental sustainability. The adoption of circular economy principles within the cattle sector can also yield long-term benefits for the agricultural sector, livestock industry, and society at large by fostering the development of more efficient and sustainable production systems. Implementing policies that promote circular economy principles can accelerate progress toward achieving the Sustainable Development Goals (SDGs), particularly in reducing waste, conserving resources, and enhancing the well-being of farmers and livestock keepers.

3.4 Potential Management of Cattle Waste Based on Circular Economy Principles

The waste generated from cattle farming can be processed into value-added products such as organic fertilizer, biogas, or briquettes. The management of cattle waste not only prevents potential environmental pollution but also has the potential to increase farmers' income and support the sustainability of the agricultural sector [21]. Processed cattle waste into organic fertilizer can benefit various sectors, including agriculture, plantations, forestry, and horticulture [22]. Data from the Central Statistics Agency indicates that each cow in Indonesia produces approximately 8 to 10 kilograms of manure daily; if managed properly, this can result in a substantial annual manure output.

Table 2
Potential Annual Manure Production from Cattle in Indonesia (2020–2024)

Year	Cattle Population (Head)	Manure per Head per Day (kg)	Potential Manure per Year (Ton)
2020	17.100.000	9	56.142.000
2021	17.300.000	9	56.592.000
2022	17.500.000	9	57.042.000
2023	17.700.000	9	57.492.000
2024	17.900.000	9	57.942.000

In addition to organic fertilizer, cattle manure can also be processed into biogas. This conversion contributes to the development of renewable energy sources and reduces dependence on fossil fuels [23]. Manure that is converted into biogas has the potential to generate energy; data indicates that 1 kilogram of cattle manure can produce between 0.023 m³ and 0.040 m³ of biogas, which is equivalent to approximately 4.7 kWh of electricity per cubic meter of biogas [24]. Solid organic fertilizer can also be produced from the processing of manure, either from biogas sludge residuals or directly from cattle feces that has undergone treatment. The moisture content in cow feces is estimated at around 60%, indicating a significant potential for processing into organic fertilizer [25].

Table 3
Potential Biogas and Solid Organic Fertilizer from Cattle Manure

Year	Biogas Potential (m ³)	Biogas Potential (kWh)	Solid Organic Fertilizer Potential (Ton)
2020	9.312.000	43.716.000	523.000
2021	9.513.000	44.721.000	529.000
2022	9.714.000	45.726.000	535.000
2023	9.915.000	46.731.000	541.000
2024	10.116.000	47.736.000	547.000

According to national data, the potential for converting cattle waste into biogas and organic fertilizer in Indonesia is substantial. In 2021, the estimated biogas production from cattle manure reached approximately 9,513,000 cubic meters, equivalent to 44,721,000 kWh of electricity. The potential solid organic fertilizer derived from cattle manure could reach up to 529,000 tons. The process of converting livestock waste into biogas produces methane (CH₄), which possesses a high calorific value, ranging between 4,800 and 6,700 kcal/m³ [26]. This potential offers significant

opportunities for the development of renewable energy and the enhancement of the agricultural sector through the production of valuable fertilizer products.

Implementing livestock waste management based on circular economy principles can minimize waste generated by the livestock and agricultural sectors, while increasing the efficiency of resource utilization. Agricultural residues can be repurposed as livestock feed, whereas livestock waste can be processed into organic fertilizer to support agricultural productivity. Therefore, collaboration between the livestock and agricultural sectors holds considerable potential in optimizing resource use and promoting environmental, economic, and social sustainability [20].

Implementing circular economy (CE) principles in cattle waste management has demonstrated significant potential to enhance environmental sustainability and farmers' livelihoods. Converting livestock waste into value-added products such as biogas and organic fertilizer reduces greenhouse gas emissions and creates new income streams contributing to rural economic resilience. Empirical evidence indicates that CE-based livestock systems have a measurable impact on farmers' income. In Bandung Regency, Indonesia, the application of integrated waste management, transforming manure into biogas and organic fertilizer, resulted in an average household income increase of 18–25% compared to conventional systems [24]. This improvement was primarily driven by reductions in household energy costs and additional revenue from the sale of compost. Similarly, in rural Iran, adopting livestock waste bioconversion technologies led to an average monthly income growth of USD 55–70 per household, reflecting a 20–30% rise in agricultural revenue [6].

Comparable findings have been reported in several regions of Indonesia. Smallholder cattle farmers participating in zero-waste farming programs in East Kalimantan experienced an income increase from approximately IDR 3.5 million to IDR 4.6 million per month within one production cycle [18]. The increase stemmed from cost savings on synthetic fertilizers and profits from selling biogas residues as organic fertilizer. The integration of circular practices within livestock and agricultural systems in Yogyakarta improved farmers' net income by up to 28%, highlighting the economic viability of sustainable waste valorization [23].

Circular economy-based livestock enterprises contributed to the transition toward a green economy by improving resource efficiency and generating new employment opportunities in rural energy sectors [25]. Processing organic market waste into cattle feed and organic fertilizer in Balikpapan increased the economic turnover of farmer groups by approximately 22% annually, while simultaneously reducing local waste accumulation [28]. The evidence collectively underscores the socio-economic benefits of integrating CE principles into livestock production.

Table 4.
Farmers' Income Before and After Implementation of Circular Economy Practices

Source	Location	Average Income Before (USD/month)	Average Income After (USD/month)	Income Growth (%)
Latif [24]	Bandung	190	230	21
Sadeghpour & Afshar [6]	Iran	230	300	30
Widiarta et al. [27]	East Kalimantan	220	290	32
Sudrajat et al. [23]	Yogyakarta	210	270	28
Rengganis et al. [28]	Balikpapan	200	245	22

The data presented above confirm that implementing circular economy practices in cattle waste management can substantially improve farmers' financial capacity and promote environmentally responsible production systems. Increased income and reduced dependence on external inputs such as chemical fertilizers and fossil fuels strengthen farmers' economic resilience while fostering local resource independence. These transformations also contribute directly to

developing a green economy, where economic growth is decoupled from environmental degradation.

At the macro level, the integration of circular economy principles within livestock production aligns closely with the objectives of the Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth) and SDG 12 (Responsible Consumption and Production). Adopting circular models enhances the efficiency of material and energy use, creating a systemic link between productivity, environmental stewardship, and long-term sustainability [7].

The findings of this study demonstrate that the circular economy framework not only mitigates environmental challenges associated with livestock waste but also drives measurable socio-economic benefits for farmers. By transforming waste into renewable energy and organic inputs, farmers can enhance profitability while contributing to climate mitigation and rural economic empowerment. Thus, the circular economy is a strategic approach to achieving integrated ecological, economic, and social sustainability within the livestock sector.

4. Conclusion

This study evaluated the potential application of circular economy (CE) principles in managing cattle waste as a strategic approach to advancing the green economy and achieving sustainable development. The results demonstrate that integrating CE practices within the cattle sector can generate substantial benefits across ecological, economic, and social dimensions. Solving livestock waste into value-added products such as biogas and organic fertilizer contributes to climate change mitigation by reducing methane emissions and improving energy efficiency and agricultural productivity through agro-industrial integration. From an economic and social perspective, these practices enhance farmers' income diversification, strengthen rural economic resilience, and create new bioeconomic value chains that support inclusive growth. However, the successful implementation of CE initiatives depends on the availability of appropriate technologies, accessible financing mechanisms, and improving farmers' technical competencies. Comprehensive policy interventions encompassing fiscal incentives, financial inclusion programs, and capacity-building initiatives are imperative to accelerate the adoption of circular economy practices in the livestock industry. The study underscores that integrating CE principles into cattle waste management represents a transformative pathway toward achieving environmentally responsible, economically viable, and socially equitable livestock production systems.

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References

- [1] Lehmann, B., Burlingame, B., Clapp, J., Solh, M. El, Kadlečíková, M., Xiande, L., Mati, M., Moseley, W., Rao, N., Rosswall, T., Sarpong, D., Shideed, K., María, J., Viñas, S., & Thilsted, S. (2020). *Food Security And Nutrition Building A Global Narrative Towards 2030*. www.fao.org/cfs/cfs-hlpe
- [2] Lee, L., & Ignaciuk, A. (2025). Mitigating climate change in the agriculture, forestry and other land use (AFOLU) sectors: A literature review on policy effectiveness. *OECD Food, Agriculture, Fisheries Papers*, 221.

- [3] IPCC. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press.
- [4] World Health Organization, "World Health Organization."
- [5] Khairul Basher, M., Nur-E Alam, M., Islam Mazumder, T., Manirul Islam, M., & Nur-E-Alam, M. (2025). A Drive for Sustainable Net-Zero Future by Leveraging Guerrilla Marketing in Circular Economy. *Mazumder et al. Journal of Applied Physical Sciences and Engineering*, 2025(1), 2025–2035. <https://doi.org/10.70274/japse.2025.1.1.48>
- [6] Sadeghpour, A., & Afshar, R. K. (2024). Livestock manure: From waste to resource in a circular economy. In *Journal of Agriculture and Food Research* (Vol. 17). Elsevier B.V. <https://doi.org/10.1016/j.jafr.2024.101255>
- [7] Noja, G.-G., Boldea, M., Purdescu, M.-I., & Lonascu, A. (2025). Transition to a Circular Economy in ASEAN-5: Inferences on Sustainable Development in a Globalised World. *Green Wealth: Navigating towards a Sustainable Future*, 117, 195–210. <https://www.emerald.com/insight/publication/doi/10.1108/S1569-37592025117>
- [8] Wang, Y., He, Y., & Gao, X. (2025). Synergizing Renewable Energy and Circular Economy Strategies: Pioneering Pathways to Environmental Sustainability. *Sustainability (Switzerland)*, 17(5). <https://doi.org/10.3390/su17051801>
- [9] Moltames, R., Noorollahi, Y., Yousefi, H., Azizimehr, B., & Naseri, A. (2025). Assessment of potential sites for biogas production plants from domestic, agricultural, and livestock waste. *Fuel Communications*, 22, 100132. <https://doi.org/10.1016/j.jfueco.2024.100132>
- [10] Li, L., Awada, T., Shi, Y., Jin, V. L., & Kaiser, M. (2025). Global Greenhouse Gas Emissions From Agriculture: Pathways to Sustainable Reductions. *Global Change Biology*, 31(1). <https://doi.org/10.1111/gcb.70015>
- [11] Baldassarre, B. (2025). Circular economy for resource security in the European Union (EU): Case study, research framework, and future directions. *Ecological Economics*, 227. <https://doi.org/10.1016/j.ecolecon.2024.108345>
- [12] Maione, G., Toscano, V., & Burkov, I. (2025). From words to action: SDG reporting insights in the Italian private sector. *Measuring Business Excellence*. <https://doi.org/10.1108/MBE-06-2024-0081>
- [13] Mignacca, B., Filippeli, S., Strazzullo, S., Tiburzi, L., & Urbinati, A. (2025). Building circular economy theories: A practical-oriented perspective and a way forward. *Journal of Industrial Ecology*. <https://doi.org/10.1111/jiec.13622>
- [14] Gautam, P., Salunke, D., Lad, D., & Gautam, A. (2025). Convergent synergy of carbon capture within the circular economy paradigm: a nexus for realizing multifaceted sustainable development goals. In *Carbon Research* (Vol. 4, Issue 1). Springer Nature. <https://doi.org/10.1007/s44246-024-00178-1>
- [15] Achillas, C., & Vlachokostas, C. (2025). Integrated Waste Management in the Circular Economy Era: Insights from Research and Practice. In *Energies* (Vol. 18, Issue 3). Multidisciplinary Digital Publishing Institute (MDPI). <https://doi.org/10.3390/en18030728>
- [16] Khairi, F., Baptista Barbosa, M. J., Da, J., & Freitas, C. (2025). Manajemen Limbah Kandang sebagai Solusi dalam Mengurangi Pencemaran Lingkungan akibat Peternakan Intensif. In *Journal Scientific of Mandalika (jsem) e-ISSN* (Vol. 6, Issue 8).
- [17] Tebai, N., Matakana, S., & Sairdama, S. S. (2025). Teknik Dasar Menanam Kopi Arabika Dan Rahasia Sukses Pemasaran Pemula Di Kampung Bomomani, Kabupaten Dogiyai. *Jurnal Pengabdian Kepada Masyarakat Nusantara (JPkMN)*, 2492–2499. <https://doi.org/10.55338/jpkmn.v6i2.6118>
- [18] Widiarta, I. P. G. D., Qamara, C., & Mayulu, H. (2025). Studi Sosial Ekonomi Pengelolaan Limbah Sapi Potong sebagai Energi Terbarukan dan Pupuk Organik dalam Kerangka Circular Economy. *FORUM EKONOMI*, 27(2), 260–273.
- [19] Rahmadani, A., Wijaya, A., Fadillah Maharani, N., Amas, A. F., Muh Akbar, A., & Syamsu, J. A. (2025). Strategi Pemanfaatan Jerami Padi Sebagai Pakan Sapi Potong Di Kecamatan Libureng Kabupaten Bone: Pendekatan Analisis Swot Strategy Of Utilizing Rice Straw As Beef Cattle Feed In Libureng District, Bone Regency: Swot Analysis Approach. *Tropical Animal Science*, 7(1), 80–94. <https://doi.org/10.36596/tas.v7i1.1833>
- [20] Firdaus, Karim, A., & Fazlina, Y. D. (2025). Pengolahan Limbah Pertanian dan Perkebunan Menjadi Pakan Ternak dan Pupuk Kompos di Desa Pedekok Kecamatan Pegasing Kabupaten Aceh Tengah. *Jurnal Pengabdian Aceh*, 5, 30–36.

- [21] Djibran, Moh. M., Andiani, P., Nurhasanah, , Dila Padila, & Mokoginta, M. M. (2023). Analisis Pengembangan Model Pertanian Berkelanjutan yang Memperhatikan Aspek Sosial dan Ekonomi di Jawa Tengah. *Jurnal Multidisiplin West Science*, 847–857. <https://wnj.westsciences.com/index.php/jmws>
- [22] Widiarta, I. P. G. D., Anindyasari, D., & Daru, T. P. (2025). Perilaku Konsumen Dalam Mengadopsi Limbah Ternak Untuk Pertanian Rumah Tangga Berbasis Urban Farming: Studi Pada Pemanfaatan Pupuk Organik Di Wilayah Perkotaan. *Jurnal Ekonomi Pertanian dan Agribisnis*, 9(3), 1084-1094.
- [23] Sudrajat, A., Susanto, D., Marhaeny Nur Isty, G., Studi Manajemen, P., Ekonomi, F., Mercu Buana Yogyakarta, U., Studi Penyuluhan Peternakan dan Kesejahteraan Hewan, P., & Pembangunan Pertanian Manokwari, P. (2025). Penerapan Ekonomi Sirkular melalui Sistem Pertanian Terpadu berbasis Zero Waste untuk Meningkatkan Ketahanan Pangan di Desa Sendangtirto, Berbah, Kabupaten Sleman Yogyakarta. *Journal of Sustainable Agriculture Extension*, 3(1), 14–21. <https://doi.org/10.47687/JoSAE.v3i1.1238>
- [24] Latif, A. (2022). Potensi Pengelolaan Limbah Ternak Sapi Berbasis Circular Economy di Kabupaten Bandung Untuk Mendukung Pembangunan Berkelanjutan. *Jurnal Syntax Fusion*, 2(11), 808–817. <https://doi.org/10.54543/fusion.v2i11.223>
- [25] Widiarta, I. P. G. D., Suarna, I. W., Muharram, F., Wijakesuma, M. H., Agung, A. P., & Qamara, C. (2025). Pengembangan Bisnis Peternakan Sapi Potong Berbasis Circular Economy dalam Mendukung Ketahanan Pangan dan Green Economy. In *Prosiding Seminar Nasional Tahun 2025 (Vol. 7, pp. 39-53)*.
- [26] Widiarta, I. P. G. D., Qamara, C., Suhardi, Fajrih, N., Wahyuningtyas, A. N., & Fanani, A. F. (2025). Dissemination of Green Marketing and Circular Economy Concepts in Goat and Sheep Farming Management to Enhance Farmers' Welfare. *Jurnal Pengabdian Masyarakat*. <https://doi.org/https://doi.org/10.55099/participative.v5i1.152>
- [27] Widiarta, I. P. G. D., Anindyasari, D., & Mayulu, H. (2025). Mengoptimalkan Limbah Sapi Potong untuk Energi Terbarukan dan Produksi Pupuk Organik dalam Kerangka Ekonomi Sirkular: Implikasi bagi Pengembangan Industri Peternakan Berkelanjutan. In *FORUM EKONOMI: Jurnal Ekonomi, Manajemen dan Akuntansi (Vol. 27, No. 1, pp. 31-41)*.
- [28] Rengganis, S. I., Zannaria, N. D., Pratiwi, R., Kartikasari, I. B., Munanto, G. B., & Oktavia, E. (2023). Economy Circular Pengelolaan Sampah Organik Pasar di Peternakan Sapi dari Hulu hingga Hilir (Studi Kasus di Kelompok Tani Sumber Makmur, Gunung Tembak Kota Balikpapan). *Jurnal Rekayasa Tropis, Teknologi, dan Inovasi (RETROTEKIN)*, 1(2), 1-12.