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Developing a Green Business Model Canvas for Sustainable Waste Management: A Qualitative Case Study of the Banyumas Green Waste Innovation Center, Indonesia

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ABSTRACT

Effective waste management remains a critical sustainability challenge in Indonesia, where increasing waste generation, limited landfill capacity, and fragmented governance structures constrain the transition towards circular economy practices. While community-based waste initiatives have been widely documented, existing studies predominantly focus on operational performance and social participation, leaving limited understanding of how such initiatives can be systematically designed as **hybrid socio-economic organisations with integrated business model architectures**. Addressing this gap, this study develops a context-specific **Green Business Model Canvas** grounded in the **Triple Layer Business Model Canvas (TLBMC)** framework to examine how economic, environmental, and social value creation can be strategically aligned within a public–community waste management institution. Using a qualitative case study approach at the Banyumas Green Waste Innovation Center (UPT TPST-BLE), the research draws on in-depth interviews with key stakeholders, non-participant observations, and analysis of institutional and operational documents. The findings reveal that the integration of diversified waste-derived products, formalised governance through the Badan Layanan Usaha Daerah (BLUD) model, and cross-sector partnerships enables the organisation to achieve financial viability while simultaneously enhancing community empowerment and environmental performance. However, the analysis also uncovers structural trade-offs between revenue generation from high-volume waste streams and long-term waste reduction objectives, highlighting inherent tensions across the economic and environmental layers of the TLBMC. Theoretically, this study extends the application of the TLBMC by demonstrating its utility as a **diagnostic and design tool for identifying cross-layer tensions in hybrid public–social enterprises**, rather than merely as a descriptive mapping framework. Practically, the proposed Green Business Model Canvas offers policymakers and practitioners a structured model for institutionalising community-based waste initiatives into scalable, accountable, and sustainability-oriented governance systems in developing country contexts.

Keywords: Sustainable Waste Management, Green Business Model, Triple Layer Business Model Canvas, Circular Economy, Community-Based Waste Innovation

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INTRODUCTION

A clean and sustainable environment plays a crucial role in supporting public health and overall community welfare while reducing the risk of disease transmission, particularly in regions experiencing rapid urbanisation and tourism-driven economic activity. Tourism destinations tend to generate disproportionately high volumes of solid waste due to increased consumption patterns and short-term visitor behaviour, which places additional pressure on local waste management systems. In the absence of effective, community-integrated waste governance, unmanaged waste accumulation can intensify ecological degradation and provoke social tensions, including conflicts over landfill access and waste facility operations (Fitriasari & Nurjannah, 2017; Hadi, 2005).

In Indonesia, waste management operates within a hybrid institutional framework involving formal actors—primarily local government agencies such as the Environmental Office (Dinas Lingkungan Hidup)—and informal actors, including independent collectors and small-scale recycling enterprises. While this dual system has contributed to improved waste recovery rates in several regions, it often lacks institutional integration and strategic alignment with long-term sustainability objectives. Law No. 18 of 2008 formally introduced a paradigm shift that reframes waste as a potential economic resource rather than a residual burden, thereby opening pathways for local circular economy initiatives that link environmental management with community-based economic development.

In Banyumas Regency, Central Java, increasing household consumption, tourism activity, and small-scale industrial growth have led to a sustained rise in daily waste generation. The establishment of the Banyumas Green Waste Innovation Center represents a local institutional response that combines waste sorting, recycling, and environmental education within a single operational platform. Despite this progress, existing collection and processing capacities remain structurally misaligned with the growing volume and composition of waste streams, particularly in the management of recyclable and high-value materials. This institutional gap highlights the need for governance models that do not merely optimise technical waste handling, but also strengthen community participation and value creation mechanisms at the local level.

Within this context, the waste bank has emerged as a community-based institutional innovation that integrates environmental management with micro-economic incentives. By applying a savings-based model in which sorted recyclable waste functions as a form of deposit, waste banks encourage household-level behavioural change while simultaneously embedding waste recovery into local economic systems. Previous studies have largely examined waste banks from perspectives of participation rates, environmental awareness, or income supplementation. However, these studies tend to treat waste banks primarily as social or environmental interventions rather than as structured organisational entities with formalised value creation, delivery, and capture mechanisms.

This study addresses a critical research gap in the existing literature by shifting the analytical focus from operational performance and social outcomes towards the institutional and business model architecture of waste banks as hybrid socio-economic organisations within a local circular economy system. While prior research has demonstrated the effectiveness of Business Model Canvas (BMC) applications in mapping waste bank activities and stakeholder relationships (Nabilah et al., 2020), limited

scholarly attention has been given to how environmental and social value layers can be systematically integrated into a coherent, operationalisable business model framework. In particular, empirical studies that adapt the Triple Layer Business Model Canvas (TLBMC) to the specific governance, resource constraints, and community dynamics of small and medium-scale waste management institutions in semi-urban Indonesian contexts remain scarce.

Building on the conceptual foundation of social entrepreneurship, this research conceptualises waste banks as mission-driven organisations that prioritise social and environmental value creation alongside economic sustainability (Santosa, 2007). The theory of change perspective is employed to clarify how waste bank activities translate into long-term social transformation through defined impact pathways, institutional collaboration, and measurable performance indicators (Syabrina, 2015). Rather than positioning waste banks as isolated grassroots initiatives, this study situates them within a broader local governance ecosystem that includes municipal authorities, community groups, and recycling market actors.

Accordingly, **the primary contribution of this article lies in the development of a context-specific Green Business Model Canvas, adapted from the TLBMC framework, that operationalises the interlinkages between economic viability, environmental stewardship, and social empowerment within the institutional setting of the Banyumas Green Waste Innovation Center.** By empirically mapping value propositions, stakeholder roles, resource flows, and impact mechanisms across the triple-layer structure, this study provides a structured model for strengthening local circular economy initiatives through institutional design rather than solely through technical waste management improvements.

Through this focused analytical lens, the article advances the literature on sustainable waste governance by demonstrating how community-based waste banks can function as formalised socio-economic institutions capable of bridging policy objectives, market mechanisms, and grassroots participation. This approach offers both theoretical refinement to the application of TLBMC in environmental entrepreneurship contexts and practical guidance for policymakers and practitioners seeking to scale waste bank models as integral components of regional sustainability strategies.

LITERATURE REVIEW

Sustainable waste management has increasingly been positioned as a strategic instrument for achieving environmental protection, economic efficiency, and social welfare within the framework of sustainable development. In developing countries, waste generation is closely associated with rapid urbanisation, tourism activities, and changing consumption patterns, which place significant pressure on existing landfill-based systems. Traditional waste management models that focus primarily on disposal have been criticised for their limited capacity to address long-term ecological impacts, such as greenhouse gas emissions, land degradation, and resource depletion. Consequently, recent literature highlights the need for integrated and circular approaches that transform waste into valuable resources, aligning waste management practices with broader sustainability and circular economy objectives (Akinci et al., 2012; UNEP, 2022). The concept of the circular economy provides a

foundational theoretical lens for understanding sustainable waste management as a system of material loops rather than linear flows. Circular economy principles emphasise reducing waste generation, reusing materials, and recycling resources to extend product life cycles and minimise environmental footprints. Scholars argue that waste should be reconceptualised as an economic asset capable of generating value through innovative processing and market-based mechanisms. This paradigm shift is particularly relevant in local government-led initiatives, where public service agencies can act as catalysts for integrating environmental goals with regional economic development strategies. Within this context, waste management centres such as the Banyumas Green Waste Innovation Center represent practical embodiments of circular economy implementation at the local level (UNEP, 2022; Widiastuti & Lestari, 2021).

Community-based waste management models have gained prominence as inclusive and participatory approaches to addressing environmental challenges. The waste bank system, widely implemented in Indonesia, exemplifies how grassroots engagement can enhance waste segregation, recycling rates, and public awareness. By adopting a financial metaphor where waste is treated as a form of savings, waste banks create economic incentives for households and communities to actively participate in waste management processes. Empirical studies demonstrate that such models not only contribute to environmental improvements but also foster community empowerment, income generation, and social cohesion (Asteria & Heruman, 2016; Fitriasari & Nurjannah, 2017). The integration of social entrepreneurship theory further enriches the understanding of sustainable waste management as a socio-economic intervention. Social entrepreneurship emphasises the creation of social value alongside economic returns, positioning organisations as agents of change that address societal problems through innovative business practices. In the context of waste management, this perspective underscores the importance of education, capacity building, and inclusive participation as central components of operational success. Theoretical frameworks such as the theory of change provide structured pathways for linking waste management activities with long-term social outcomes, including improved livelihoods, enhanced environmental awareness, and strengthened institutional collaboration (Santosa, 2007; Syabrina, 2015).

The evolution of sustainability-oriented frameworks reflects growing recognition that traditional profit-centred models are insufficient to address complex environmental and social challenges. Osterwalder's Business Model Canvas (BMC) offers a systematic representation of how organisations create, deliver, and capture value through interrelated components such as key partners, activities, resources, and revenue streams. However, scholars argue that the conventional BMC primarily emphasises economic value creation, thereby necessitating extensions that explicitly incorporate environmental and social dimensions. This theoretical development forms the basis for more holistic models capable of supporting sustainable enterprise design (Osterwalder, 2010; Nabilah et al., 2020). The Triple Layer Business Model Canvas (TLBMC), introduced by Joyce and Paquin (2016), represents a significant advancement in sustainability-oriented business modelling. By structuring the business model across three interconnected layers—economic, environmental, and social—the TLBMC enables organisations to visualise and manage trade-offs and synergies between financial performance, ecological impact, and social value. This framework aligns closely with the triple bottom line concept, which advocates balancing profit, planet, and people. In waste management systems, the TLBMC provides a comprehensive analytical tool for mapping how waste processing activities generate

revenue, reduce environmental burdens, and contribute to community development simultaneously (Joyce & Paquin, 2016; Abbasnia et al., 2023).

Empirical applications of the TLBMC in waste and recycling contexts highlight its practical relevance for designing sustainable operational strategies. Aruni et al. (2023) demonstrate that the framework facilitates the identification of key partners, such as local governments, SMEs, and technology providers, while clarifying the relationships between resource inputs, value propositions, and stakeholder outcomes. Similarly, studies on community-based recycling initiatives reveal that the TLBMC supports strategic alignment between economic viability and environmental performance by embedding sustainability metrics within core business activities. These findings suggest that the TLBMC can serve as a robust platform for institutionalising sustainability in public service-oriented waste management centres. Environmental performance assessment constitutes a critical dimension of sustainable waste management literature. Scholars emphasise the importance of eco-efficiency, which seeks to deliver competitive goods and services while reducing ecological impacts and resource intensity. Technological innovations such as composting systems, plastic recycling machinery, biodiesel production from used cooking oil, and digital monitoring tools like SCADA systems are frequently cited as enablers of environmentally responsible operations. These technologies not only enhance processing capacity and emission control but also contribute to transparency and regulatory compliance, reinforcing the legitimacy of waste management institutions in the eyes of stakeholders (Rifa'atussa'adah & Prabawani, 2017; Mili, 2023).

The social dimension of sustainable waste management is closely linked to the conceptualisation of social impacts and stakeholder engagement. Vanclay (2002) emphasises that social impact assessment must account for changes in community well-being, social relations, and institutional trust arising from development interventions. In the context of waste governance, educational programmes, training initiatives, and inclusive employment opportunities are widely recognised as mechanisms for strengthening social capital and promoting pro-environmental behavioural change. Existing studies further suggest that waste management centres engaging schools, universities, non-governmental organisations, and local communities can function as hubs of environmental education and social innovation, extending their influence beyond technical waste processing into broader community development and empowerment agendas.

However, despite this growing body of literature, **current research remains largely fragmented along disciplinary lines**. Environmental studies tend to prioritise technical efficiency and waste diversion outcomes, while social entrepreneurship research focuses on participation, awareness, and social value creation. **Limited scholarly attention has been given to how these social and environmental objectives are institutionally integrated into a coherent and operational business model architecture, particularly within public or semi-public waste management organisations in developing country contexts.** As a result, there is a lack of empirically grounded frameworks that explain not only *what* social and environmental impacts are generated, but *how* such impacts are structurally embedded in organisational design, governance arrangements, and value creation mechanisms.

Addressing this gap, this study positions the development of a **Green Business Model Canvas** for the Banyumas Green Waste Innovation Center as an integrative analytical and design response to the intertwined challenges of environmental degradation, economic

sustainability, and social inclusion. By operationalising the **Triple Layer Business Model Canvas (TLBMC)** framework, this research moves beyond descriptive accounts of stakeholder engagement and sustainability outcomes to examine how **economic, environmental, and social value are strategically aligned, negotiated, and institutionalised within a hybrid public–community governance setting**.

The primary contribution of this study to the existing literature is twofold. **Theoretically, it extends the application of the TLBMC by demonstrating its utility as a diagnostic framework for identifying cross-layer tensions and trade-offs such as those between formalised governance structures and community autonomy, or between revenue generation and long-term waste reduction objectives within sustainability-oriented public enterprises.** Practically, it offers a context-specific, empirically grounded Green Business Model Canvas that provides policymakers and practitioners with a structured model for transforming community-based waste initiatives into accountable, scalable, and socially embedded institutions that support local circular economy strategies. In doing so, the study advances the understanding of sustainability-oriented business models as not merely technical tools, but as **institutional instruments for inclusive and resilient development in emerging economy settings.**

METHODS

This research was conducted at the Banyumas Green Waste Innovation Center (UPT TPST-BLE) in Banyumas Regency, Central Java Province, in April 2025. The study employed a qualitative research approach using a single-case study design to enable an in-depth exploration of the institutional, organisational, and socio-economic dynamics of the waste bank system within its real-life operational context. Following Creswell (1998), the case study approach was selected to capture the complexity of interactions between community actors, local government institutions, and market mechanisms that shape sustainable waste management practices.

Primary data were collected through semi-structured, in-depth interviews and non-participant field observations. Informants were selected using purposive sampling based on their formal roles, decision-making authority, and direct involvement in waste bank operations and local waste governance. The twelve key informants represented three main stakeholder groups: (1) local government units and technical managers of the Innovation Center, (2) community leaders and waste bank administrators, and (3) waste collectors and recycling practitioners. This stakeholder-based categorisation enabled the study to capture multiple perspectives on value creation, institutional coordination, and operational constraints within the waste bank system. Secondary data were obtained from policy documents, operational reports, institutional records, and relevant academic literature to contextualise and corroborate the primary findings.

All interviews were audio-recorded with participants' consent and transcribed verbatim. The qualitative data analysis followed a systematic, multi-stage coding process informed by thematic analysis principles. First, an **open coding** phase was conducted to identify recurring concepts, practices, and challenges related to waste management, stakeholder roles, resource flows, and community engagement. These initial codes were derived inductively from the data to preserve the empirical grounding of the analysis. Second, during the **axial coding** phase, related codes were grouped into higher-order categories

that reflected institutional functions, value propositions, governance mechanisms, and impact pathways. This process enabled the identification of structural relationships between operational practices and broader sustainability objectives.

To operationalise the Triple Layer Business Model Canvas (TLBMC) as an analytical framework, the categorised themes were systematically mapped onto the three interrelated layers—economic, environmental, and social—each consisting of nine core elements. Data segments related to financial flows, revenue mechanisms, partnerships, and resource utilisation were assigned to the **economic layer**, particularly to elements such as key partners, key activities, value propositions, and cost–revenue structures. Themes concerning waste reduction, material recovery, ecological impact, and environmental education were mapped to the **environmental layer**, including material flows, environmental benefits, and lifecycle considerations. Meanwhile, findings related to community participation, institutional collaboration, capacity building, and social outcomes were aligned with the **social layer**, encompassing stakeholder relationships, social value creation, and governance structures. This deductive mapping process ensured conceptual consistency between empirical findings and the theoretical constructs of the TLBMC framework.

The analytical process was iterative, allowing for continuous refinement of codes and categories as new patterns emerged across data sources. Cross-layer comparisons were conducted to identify points of alignment and tension between economic viability, environmental performance, and social objectives, thereby revealing the institutional trade-offs and synergies embedded in the waste bank model.

To enhance the **validity and credibility** of the findings, several qualitative trustworthiness strategies were employed. **Data triangulation** was achieved by comparing insights from interviews, field observations, and documentary sources to verify consistency across stakeholder perspectives and institutional records. **Member checking** was conducted by sharing preliminary interpretations and the draft TLBMC mapping with selected informants to confirm the accuracy of representations and to reduce interpretive bias. Additionally, a clear **audit trail** was maintained, documenting the stages of data collection, coding decisions, and analytical memos to ensure methodological transparency and replicability. Reflexive notes were also recorded throughout the research process to acknowledge the researchers' positionality and to mitigate potential subjective influence on data interpretation.

Through this structured qualitative analysis and systematic integration with the TLBMC framework, the study provides a methodologically robust basis for developing a context-specific Green Business Model Canvas that reflects the empirical realities, institutional dynamics, and sustainability challenges of the Banyumas waste bank system.

RESULTS

The establishment of a Regional Public Service Agency (BLUD) at the Banyumas Green Waste Innovation Center (UPT TPST-BLE) reflects an institutional shift from a predominantly service-oriented waste management unit towards a hybrid organisational form that combines public service mandates with revenue-generating mechanisms.

Consistent with Joyce and Paquin's (2016) conceptualisation of the Triple Layer Business Model Canvas (TLBMC), this transition can be interpreted as a strategic reconfiguration of the **economic layer**, in which the organisation's value capture logic is formalised through regulated income streams while remaining embedded within public governance structures. This finding extends prior literature that primarily frames waste banks as informal or community-led initiatives by demonstrating how they can evolve into semi-formal public enterprises without entirely relinquishing their social mission.

Empirically, the projected financial viability of the BLUD model driven largely by residual waste processing and organic waste valorisation illustrates a central **theoretical tension between economic scalability and environmental prioritisation**. While high-volume residual waste streams offer predictable revenue flows, they may inadvertently reduce incentives for upstream waste reduction and household-level source separation, a dynamic also noted in circular economy literature that warns against "recycling lock-in" effects (Akinci et al., 2012; Joyce & Paquin, 2016). Within the TLBMC framework, this tension manifests as a potential misalignment between the **economic layer's revenue model** and the **environmental layer's value proposition** of minimising material throughput. The Banyumas case thus contributes to theory by empirically illustrating how public-sector waste enterprises may face structural trade-offs between financial sustainability and environmental ambition.

From a technological and operational perspective, the adoption of capital-intensive processing technologies such as pyrolysis and mechanised composting reshapes the organisation's **key resources and key activities** within the economic layer, while simultaneously redefining its **environmental benefits and material flows** in the environmental layer. Prior studies emphasise that technological upgrading in sustainable business models often enhances efficiency but can also increase dependency on external suppliers, energy inputs, and specialised technical skills (Aruni et al., 2023; Mili, 2023). In the Banyumas context, this creates a **resource dependency trade-off**, where improved processing capacity strengthens economic performance but potentially weakens organisational resilience if institutional support or budget allocations fluctuate. Theoretically, this finding nuances the TLBMC assumption of synergistic alignment across layers by highlighting conditions under which technological advancement may generate cross-layer vulnerabilities.

Socially, the BLUD model positions UPT TPST-BLE as both a service provider and a community development platform. Stakeholder interviews reveal that employment creation, skills development, and the stimulation of micro-enterprises constitute central elements of the organisation's **social value proposition**. This aligns with social entrepreneurship theory, which frames hybrid organisations as vehicles for balancing mission-driven objectives with market-based instruments (Santosa, 2007). However, the formalisation of governance structures—particularly the central role of the Regent and supervisory board—introduces a **governance trade-off** between administrative accountability and community autonomy. While institutionalisation enhances transparency and regulatory compliance, it may constrain the participatory flexibility that often underpins grassroots engagement in waste bank initiatives (Asteria & Heruman, 2016). This finding contributes to the theoretical debate on whether formalisation strengthens or dilutes the social embeddedness of community-based enterprises.

The alignment of UPT TPST-BLE's operational framework with SDG 12 reinforces the **normative dimension** of the environmental layer, positioning sustainability goals as a source of institutional legitimacy rather than solely as performance indicators. In TLBMC terms, this reflects a shift in the organisation's **value proposition** from purely functional waste processing towards broader socio-environmental stewardship. Nevertheless, empirical evidence from the Banyumas case suggests that SDG alignment remains largely symbolic unless translated into measurable environmental performance metrics, such as reductions in landfill dependency or improvements in household-level waste segregation rates. This limitation underscores a broader theoretical critique of sustainability frameworks that risk becoming "aspirational overlays" rather than operational drivers within business model design.

The mapping of stakeholder relationships across the three layers reveals structural asymmetries in value distribution. Government entities and technology providers dominate the **economic and environmental layers** through control over capital, regulation, and infrastructure, whereas community actors are more prominently situated within the **social layer** as beneficiaries and participants. This segmentation challenges the TLBMC premise of balanced, integrated value creation and suggests the persistence of hierarchical value chains even within ostensibly participatory circular economy models. The Banyumas case thus contributes empirically to emerging critiques of inclusive innovation frameworks by demonstrating how institutional power differentials shape the practical realisation of sustainability-oriented business models.

Despite its analytical strengths, the proposed Green Business Model Canvas for UPT TPST-BLE exhibits several **contextual and methodological limitations**. First, the model is derived from a single-case study within a semi-urban Indonesian setting, which constrains its generalisability to regions with different regulatory environments, market structures, or levels of community participation. Second, the reliance on qualitative stakeholder perceptions introduces the potential for normative bias, particularly in assessments of social and environmental impact. Third, the static nature of the TLBMC representation may inadequately capture the dynamic evolution of waste governance systems, where regulatory changes, market volatility, and political leadership shifts can rapidly alter organisational priorities and resource allocations.

Theoretically, this study extends the application of the TLBMC framework by demonstrating its utility not merely as a descriptive mapping tool, but as a **diagnostic instrument for identifying cross-layer tensions and institutional trade-offs in hybrid public–community enterprises**. Practically, the findings suggest that policymakers and practitioners should move beyond technical optimisation of waste processing and instead adopt governance and incentive structures that explicitly address misalignments between financial sustainability, environmental performance, and social inclusion. In this sense, the Banyumas case offers a model for critically informed circular economy implementation, where business model design becomes a site of negotiation among competing sustainability logics rather than a presumed arena of harmonious alignment.

DISCUSSION & CONCLUSION

The centre's key resources encompass the necessary machinery and equipment, skilled operators, administrative staff, supervisory personnel, and the 3.5-hectare operational site at Wlahar Wetan. Financial resources derive from initial government funding through

APBN and APBD, as well as projected BLUD revenues, while technological systems such as SCADA support operational monitoring. The value proposition of the centre lies in delivering environmentally sustainable waste management with zero-residue targets, creating economic value from waste, enhancing local livelihoods through employment and skill development, and providing educational and eco-tourism experiences that raise awareness of sustainability practices (Osterwalder, 2010; Joyce & Paquin, 2016; Mili, 2023).

Target customer segments include municipal authorities requiring public waste management services, local communities and households, SMEs and industries in need of recycled materials, tourists visiting eco-tourism facilities, and environmental NGOs or educational institutions. Engagement with these stakeholders occurs through direct sales, community workshops, on-site eco-tourism offerings, partnerships with local businesses, and transparent reporting on environmental outcomes. Revenue streams are generated through fees for residual waste processing, sales of organic and inorganic waste-derived products, and entry fees for eco-tourism facilities, supplemented by potential grants or subsidies for environmental initiatives. The cost structure incorporates personnel expenses for operators, administrative staff, supervisors, cleaning services, and drivers, alongside operational costs such as utilities, fuel, maintenance, and spare parts for machinery. Additional costs arise from infrastructure development, administrative and compliance obligations under BLUD management, and investments in technological upgrades to expand processing capabilities. Together, these elements form a comprehensive economic framework, highlighting the potential of UPT TPST-BLE to convert waste management into a sustainable and economically viable enterprise that benefits both the local community and the broader environment (Nabilah et al., 2020; Abbasnia et al., 2023; Aruni et al., 2023).

The environmental dimension of the business model for the Banyumas Green Waste Innovation Center (UPT TPST-BLE) focuses on maximising resource efficiency, reducing environmental impact, and promoting circular economy principles throughout the waste management life cycle. Key partners include technology suppliers of environmentally friendly machinery, local recycling companies, environmental NGOs, and government agencies responsible for monitoring and regulating waste management practices. Central activities in this layer involve the collection, segregation, and processing of organic and inorganic waste, composting, conversion of used cooking oil to biodiesel, maggot cultivation, and recycling of plastics into paving, tiles, and other value-added products. Additionally, the centre implements monitoring systems such as SCADA to track emissions, energy consumption, and waste processing efficiency. Key resources supporting environmental performance encompass advanced processing equipment, green infrastructure such as wastewater treatment and renewable energy systems, skilled environmental operators, and knowledge-based resources for training and innovation in sustainable waste management. The centre's value proposition in environmental terms lies in providing zero-residue waste processing, minimising landfill usage, mitigating greenhouse gas emissions, promoting the sustainable use of natural resources, and enhancing ecological awareness among visitors and local communities (UNEP, 2022; Rifa'atussa'adah & Prabawani, 2017; Mili, 2023).

Customer segments for the environmental dimension extend beyond traditional stakeholders to include government regulators seeking compliance with environmental standards, local communities benefiting from a cleaner environment, eco-conscious

tourists, educational institutions, and environmental advocacy groups. Channels for engagement include eco-tourism visits, environmental education workshops, community outreach programmes, public reporting on environmental performance, and collaboration with research institutions for continuous improvement. Revenue streams in this layer are indirectly linked to environmental performance through premium products such as organic fertilisers and recycled goods, eco-tourism and educational fees, and potential incentives or grants for achieving sustainability targets. The cost structure includes investments in pollution control technologies, energy-efficient machinery, renewable energy infrastructure, water treatment systems, ongoing monitoring, and compliance with environmental regulations (Abbasnia et al., 2023; UNEP, 2022).

The social dimension of the business model for the Banyumas Green Waste Innovation Center (UPT TPST-BLE) emphasises community empowerment, education, and inclusive stakeholder engagement, recognising that sustainable waste management extends beyond economic and environmental benefits. Key partners in this dimension include local communities, educational institutions, community organisations, government agencies, and NGOs focusing on social welfare and environmental education. Core activities encompass conducting public awareness campaigns, training programmes for local residents in waste sorting and processing, educational workshops for students and tourists, and initiatives to foster entrepreneurship through the production of value-added waste products. These activities aim to cultivate social cohesion, enhance skills, and generate employment opportunities. Key resources comprise skilled personnel for community outreach and education, training materials, infrastructure for workshops and educational facilities, and knowledge-based assets for developing innovative social programmes. The value proposition from a social perspective lies in improving community livelihoods, providing equitable access to training and economic opportunities, raising environmental consciousness, and fostering social inclusion, particularly for marginalised groups such as youth and women (Santosa, 2007; Vanclay, 2002; Widiastuti & Lestari, 2021).

Customer segments include local residents participating in training and waste banking programmes, school and university students engaging in educational activities, tourists visiting eco-tourism facilities, social enterprises utilising recycled products, and governmental bodies seeking to enhance public welfare. Channels for interaction involve hands-on workshops, collaborative community projects, educational tours, and digital platforms for knowledge dissemination. Revenue streams linked to social impact can be generated indirectly through fees for training programmes, participation in community initiatives, sales of social enterprise products, and potential grants from governmental or international organisations supporting social innovation. The cost structure reflects expenditures for educational programme development, staffing for outreach and supervision, community engagement events, and operational support for training facilities (Asteria & Heruman, 2016; Syabrina, 2015).

The development of the Green Business Model Canvas for the Banyumas Green Waste Innovation Center (UPT TPST-BLE) integrates economic, environmental, and social dimensions to establish a comprehensive framework for sustainable waste management. From an economic perspective, the centre leverages a diversified revenue model including fees from waste processing, sales of organic and inorganic recycled products such as maggot, kasgot, compost, biodiesel from used cooking oil, paving, and tiles, as well as eco-tourism services like hot spring pools. Key partners in this dimension include local

government agencies, suppliers, technology providers, and financial institutions, while essential resources encompass processing equipment, operational vehicles, skilled personnel, and infrastructure. Core activities focus on waste collection, segregation, processing, and value-added production, with the value proposition centred on creating profitable, sustainable operations that benefit both the community and regional development (Osterwalder, 2010; Nabilah et al., 2020).

UPT TPST-BLE emphasises the reduction of environmental impact and the promotion of circular economy principles. Key partners include environmental NGOs, technology providers of green machinery, and government regulatory bodies. Activities cover composting, plastic recycling, biodiesel production, maggot cultivation, and continuous monitoring using SCADA systems to track emissions and energy use. Critical resources include green infrastructure, renewable energy systems, and trained environmental operators. The centre's environmental value proposition lies in achieving zero-residue waste processing, minimising landfill usage, reducing greenhouse gas emissions, and fostering ecological awareness among the local community and visitors. Revenue streams in this dimension are indirectly tied to environmentally sustainable products and eco-tourism initiatives, while cost structures reflect investments in pollution control, energy-efficient machinery, and regulatory compliance (UNEP, 2022; Joyce & Paquin, 2016; Mili, 2023).

The social dimension highlights community empowerment, education, and inclusive stakeholder engagement. Partners include local residents, schools, universities, NGOs, and government agencies. Activities consist of public awareness campaigns, training programmes for waste management, workshops for students and tourists, and initiatives promoting entrepreneurship through value-added waste products. Key resources comprise skilled personnel, training materials, and community facilities, while the value proposition emphasises social inclusion, improved livelihoods, and increased environmental consciousness. Customer segments range from local residents participating in waste banking programmes to tourists and educational institutions. Socially linked revenue streams include training fees, participation in community programmes, and grants from government or international organisations supporting social innovation, with cost structures reflecting expenditures for outreach, staffing, and educational programmes (Asteria & Heruman, 2016; Santosa, 2007; Widiastuti & Lestari, 2021).

In conclusion, this study set out to address a critical gap in the literature by examining how a community-based waste management institution can be systematically designed as a **hybrid socio-economic organisation** through the **Triple Layer Business Model Canvas (TLBMC)** framework. The findings demonstrate that UPT TPST-BLE's transition towards a formalised BLUD model enables the strategic alignment of **economic value capture, environmental value creation, and social value delivery**, thereby operationalising the core theoretical premise of TLBMC within a public–community governance context.

From a theoretical perspective, this research extends the application of the TLBMC beyond descriptive business model mapping by evidencing its function as a **diagnostic tool for identifying cross-layer tensions and institutional trade-offs**, particularly between revenue generation from high-volume waste streams and long-term waste reduction objectives, as well as between formal governance structures and community autonomy.

These insights contribute to the broader literature on sustainable business models and social entrepreneurship by empirically illustrating how sustainability-oriented value propositions are negotiated within hybrid public enterprises in developing country settings.

Practically, the proposed **Green Business Model Canvas** offers policymakers and practitioners a structured framework for institutionalising community-based waste initiatives into accountable and scalable public service organisations. By explicitly linking stakeholder roles, resource flows, and performance indicators across the economic, environmental, and social layers, the model supports evidence-based decision-making for enhancing financial viability, environmental performance, and social inclusion in local circular economy initiatives.

Despite these contributions, this study is subject to several limitations. The reliance on a **single qualitative case study** constrains the generalisability of the findings to regions with different regulatory environments, market conditions, and levels of community engagement. Furthermore, the use of stakeholder interviews as the primary data source introduces the potential for **normative and social desirability bias** in the assessment of social and environmental impacts. The static representation of the TLBMC also limits the ability to capture the **dynamic evolution of institutional arrangements** in response to policy shifts, technological change, and market volatility.

Future research should adopt **comparative multi-case designs** across diverse regional and governance contexts to test the transferability and robustness of the proposed Green Business Model Canvas. Longitudinal studies are recommended to examine how cross-layer trade-offs evolve over time, particularly in relation to policy reforms, revenue stability, and community participation. In addition, integrating **quantitative performance indicators**—such as waste diversion rates, lifecycle carbon metrics, and social return on investment (SROI)—would enable more rigorous evaluation of the causal linkages between business model design and sustainability outcomes.

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